How sixth form students conceptualise their learning dispositions, roles and relationships in the research-based learning culture of a single case study school

By

Alan Jones

Canterbury Christ Church University

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Abstract

The focus of this thesis is the case study of a single, selective school aiming to challenge students to engage in what it has called *research-based learning*, a pedagogy framed as an alternative to traditional approaches common in most secondary schools. Using a critical realist lens, the thesis aims to develop an understanding of how sixth form students at the school conceptualise their learning in challenging real-world research projects. It presents rich descriptions of practices within the school, based mainly on the intrinsic case study approach of Stake and the open evaluative approach of Bassey, revealing four key outcomes around areas related to student autonomy, the efficacy of different kinds of learner support, student motivation and the achievement of real-world professionalism. First, it reveals that student autonomy can be liberating but also highly challenging and disorientating. Second, it shows that students in autonomous roles generally conceptualise the minimal scaffolding of the school as positive, but also that some students from less open learning environments may need extra support. Third, it demonstrates that students' motivations are often blends of extrinsic and intrinsic elements, showing subtle understandings of their roles as learners inside and outside conventional curricula. Fourth, it reveals that students vary in their achievement of real-world professionalism within communities of practice, but that some appear to carry out genuinely innovative work that goes beyond merely peripheral involvement. Emerging from these outcomes, the study finds successes in the school's resistance to conventional pedagogy, but argues there are also ambiguities within its cultural context. It also contributes to the literature on transformative learning, revealing how the transformation at the core of Bhaskar's critical realism can be seen alongside Mezirow's idea of personal growth to indicate ways in which learners undergo change and simultaneously generate change in institutions.

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Chapter One: Introduction

1.1. An overview: personal perspectives in embarking on this research

When I embarked on this study, I was a researcher carrying out research in my professional area of expertise – school teaching. Yet I had retired from my professional role, and could therefore lay claim to the ambiguity of simultaneous insiderness and outsiderness. It was an unusual position, and my aim in this short section is to explain my personal reasons for embarking on research at all from this very unusual standpoint.

Whilst a postgraduate student studying for a Masters degree, I began to think of myself, during the dissertation stage, as a competent researcher who could go on to enjoy, and be successful at, doctoral level research. Unfortunately, at that time the need for gainful employment became pressing. As a result, I trained to teach and accepted a post teaching English to very high-functioning students.

I enjoyed my professional life in two schools, and retained a taste for research and publication through two articles for established periodicals and several informal papers for educational groups and my local university. When I was offered the possibility of carrying out doctoral work financially supported by the school in which I was working, I ought to have seized the chance then, but didn't, citing time-consuming professional work, ironically the very professional work that would have been significantly enriched by doctoral-level thinking.

When the offer was made to me again on my retirement, there was thus a mixture of feelings – I had missed out at university, but also in my professional life, largely through my own lack of boldness and determination. This time, I accepted the challenge,

realising that I would be able to contribute to an area of knowledge about education at the same time as pursuing doctoral work for its own sake and its own challenge.

For this reason, in planning for the research itself and thinking about what might motivate students both to become involved in research and to volunteer themselves as participants in my study, I became aware of a certain irony – here would be students, unlike my earlier self, making the most of opportunities offered, accepting challenges and enriching their skills as they created their own knowledge. I would feel the pain and pleasure of their commitment, and that would drive me forward as much as any more objective focus. Mine would be a research position of genuine admiration as well as experience, an absorption as much as a standing-back. I would be immersed and floating at the same time, a different kind of ambiguity.

1.2. My ethical position

1.2.1. Introduction

It is unlikely that the professional and emotional ambiguities of my position as researcher made it unique, but, as a retired teacher and senior leader revisiting my school and making it the focus of my study at the invitation of my former head teacher, it was certainly unusual (I found nothing in the literature, for example, which made reference to this specific position). Thus, the consideration of relevant ethical issues lay outside the familiar outsider/insider range. As researcher, I was also funded as a doctoral student by my former school, an additional factor which needed to be considered. Like many researchers, though, I began with the undeniable fact that 'fully ethical research is impossible' and that 'in the end researchers have to take decisions about how to carry out research that make the process as ethical as possible within the frameworks of the project' (Busher and James, 2002: 118).

1.2.2. My position as insider/outsider

Because of my absence from the research site through retirement, I believe my researcher position at the beginning of the study could best be described as 'outsider with significant insider knowledge'. I saw this position, positively, as rich in potential depth of understanding rather than ethically untenable, but this is a view that cannot stand without defence.

The purely insider position is commonly defended through an anti-positivist approach and an emic rather than etic methodology which makes an effort to 'get inside the person' (Cohen et al., 2011: 21) and which acknowledges that no outsider can be as knowledgeable about practice and its social context as an insider (Scott and Usher, 1999: 37, 100-101). By contrast, however, there are those who see the insider position as open to the 'myopia' of over-familiarity, taking things for granted and being unwilling to challenge embedded assumptions (Mercer, 2007: 6), preferring the opposite position of outsider neutrality and detachment (ibid: 5). A more nuanced approach is perhaps to acknowledge that the boundaries between insiderness and outsiderness are unstable, there being multiple positions which produce a fluctuating relationship between researcher and researched, positions conditioned by similarities or differences of, for example, gender, age, political stance and social class (see Costley et al., 2010: 40-41; Mercer, 2007: 3,4,13).

This is not to suggest that there are not 'explicit tensions' in the idea of, for example, an educational practitioner taking on the dual role of teacher and researcher (BERA, 2011: 5), tensions which manifest themselves through issues of confidentiality (ease of identification) and student progress and welfare (prioritising these over research) (Nolen and Putten, 2007: 403).

I would argue, however, that my own position as researcher allowed me, unusually, to have the best of both worlds. I had been almost wholly disconnected from my place of employment for over four years; the sixth form participants in the study were thus unlikely to feel I was an insider in any real sense. There were no issues of confidentiality or prioritisation since I did not currently teach at the school. Nevertheless, I retained a strong awareness of its ethos and culture, facilitating ease of access and enhanced understanding, tempered by a critical stance developed through doctoral study and temporal distance. Thus, my approach was both emic and etic, avoiding the 'deception' of the traditional insider role (Costley et al., 2010: 31).

1.2.3. Funding relationships

Funding of the course for which my research study is the last phase was provided by the school which is the focus of the research, my involvement having been precipitated by an invitation from its principal gatekeeper. This draws the obvious criticism that I, as a researcher, might have been unduly influenced by my acceptance of the funding when finalising the precise nature of the research, considering particular methodologies and methods, identifying participants and, especially, interpreting the data and coming to final conclusions.

As Resnik and Elliott remind us, 'in some situations, there is little need to be concerned about financial relationships because they are not likely to influence the research results', whereas in other instances, 'considerable concern is warranted' (Resnik and Elliott, 2013: 186). I believe the context for my own research, when seen in the light of, for example, the funding of large-scale studies in medicine by powerful global drugs companies, was relatively benign. Although my study meets Bryman's case of research whose 'main thrust' derives from 'the availability of funding or approaches by sponsors'

(Bryman, 1988: 10), it is important to recognise that all ethics are 'situated' in particular 'specificities of the research situation' in which ethical decisions 'cannot be reached by appeal to unambiguous and univalent principles or codes' (Simons and Usher, 2000: 2). Busher and James agree, demonstrating that such 'principles or codes' cannot be mechanistically applied when research 'involves a series of emergent or immanent ethical moments….throughout the life of a research project' (Busher and James, 2002: 108).

It is perhaps inevitable that funded researchers will be seen by some as 'extensions' of sponsors, 'despite denials to the contrary' (Denzin and Lincoln, 1994: 86), and that gatekeepers might 'exercise power to manipulate discourses' within the organization, including the discourse of research (Costley et al., 2010: 39). As a result of this perceived influence, 'there is undoubtedly the possibility that funded researchers will wittingly or unwittingly, produce "favourable" results' (Robson, 2011: 226).

It is easy, however, for such suspicions to become established without evidence and for disclosures of financial relationships to precipitate '*ad hominem* attacks on researchers that distract the readers' attention from an objective evaluation', resulting in 'crude, unreliable assessments of research credibility' (Resnik and Elliott, 2013: 185, 199). More objective and reliable assessments of credibility must surely depend on the degree to which the researcher retains 'the right to conduct the study as he or she thinks fit, informed by, but not decided by, the sponsor', upholding the key principle that 'the researcher's integrity must be absolute' (Cohen et al., 2011: 102). The key question, in other words, is: who defines the research focus? If the definition lies substantially outside the control of the researcher, this may lead to significant ethical tensions.

The principle of researcher integrity is best enshrined, according to BERA, in written agreements between researchers and sponsors which nevertheless recognise the 'dynamics of research', contain 'provision for negotiating changes sought by either the researchers or the sponsors' and are coupled with clear communication to the sponsors of intentions, choice of methodologies, methods and participants and approaches to collection and analysis of data (BERA, 2011: 8 – 9). Such an agreement was drawn up for the conduct of my research (see Appendix 1).

1.2.4. Conflicts of interest

One of the most obvious forms which a questionable financial relationship can take is, of course, that of an outright conflict of interest. For Beauchamps, interest in this context 'refers to any influence such as loyalty, continued employment, tenure, status, position, or financial incentive' which could 'compromise or otherwise interfere with a person's ability to act independently' in a position of trust (Beauchamps, 1992: 9). The issues of employment, tenure, status and position were irrelevant to my position as researcher, and there was, I would maintain, no 'financial incentive' as such. However, Beauchamps places 'loyalty' at the head of the list, and this is a more intangible, subtle potential influence which, it is certainly true, could be perceived as having had an effect in my case.

If continued loyalty to my former place of employment is to be regarded as a potentially unethical influence on the conduct of my research, then it is likely to have been a covert effect. Such effects are certainly recognised by some writers, acknowledging for example that 'researchers may be affected….even when they do not deliberately manipulate methods, data, or results' (Resnik and Elliott, 2013: 192). But to what extent can this kind of influence be counteracted? As Curzer and Santillanes point out,

researchers ‘dwell within a web of duties’ to different people, communities, institutions and societal values, one or more of which could result in the kind of influence described above (Curzer and Santillanes, 2012: 144). Such potential influences, deriving from the multiple perspectives outlined by Costley et al. (2010) and Mercer (2007) are surely always likely to be present.

This covert aspect aside, it seems, in any case, ill-advised to treat the idea of conflict of interest too broadly. As Beauchamps points out, ‘we should not say that there is a conflict of interest whenever money changes hands and a person is in a position of trust’ (Beauchamps, 1992: 10). He continues by offering a distinction between three kinds of conflict of interest, the potential, the perceived and the real, arguing that, in the case of the first two, it would be ‘morally dubious’ to ask a researcher to abandon a study on the basis of the perceptions of others which could be unjustified (ibid: 11). In the case of my own research study, I believe concerns as to undue influence must be accounted as having been potential and (possibly) perceived, but not in any quantifiable sense real.

Nonetheless, the guiding principles and suppositions all researchers may start with, whether overt or covert, whether influenced by financial or other relationships or by theory, must be subjected to questioning, and this questioning, what Schon calls ‘double vision’ (Schon, 1991: 281), must, ideally, appear on the surface of the inquiry, a ‘reflexive critique’ which begins to form a ‘dialogue between writers and readers concerning *possible* interpretations of experience’ (Winter, 1989: 42-43, original emphasis). This is a form of ‘critical pragmatism’ (Barone, 1992: 32) which foregrounds the range of possible meanings explored in the study (Busher and James, 2002: 117), so that the writing assumes, at least to some extent, a ‘plural structure’ (Winter, 1996: 23), with clear ‘evidence of participants’ voices’ (Busher and James, 2002: 115).

To sum up: no research can proceed with complete objectivity and ethical certainty and all research is, to some degree, 'situated'. However, my position as former insider avoided a good deal of the tension and inherent deception of the pure insider position, whilst affording me a rich understanding of the research context. In terms of conflict of interest, I believe it is vital to demonstrate open and coherent approaches to research which challenge and question context and theory and that these approaches must be on the surface of the writing in the final thesis in order to offset any perceived or potential bias with regard to former loyalties. The provision of a signed research agreement between myself as researcher and the school's principal gatekeeper provided a supportive statement of intentions and ethical positions against which provisional findings and the final research report could be judged.

1.3. Objectives and research questions

This study, then, as discussed above, formed an investigation into one school's research-based pedagogy, a pedagogy which had enormous potential in terms of depth and intensity of learning, but which also carried assumptions which needed rigorous, critical examination. The school's view of this pedagogy has been usefully summarised in part of a draft document written by the head teacher himself:

> At the [case study school] we offer [students] an alternative intellectual challenge beyond the established expectations for young people of the same age. This alternative challenge is an entitlement for all our students and includes….a wide range of research projects in the sciences, arts and humanities. Our aim in delivering this 'extended….curriculum' is to address the social skills (or the 'soft skills' as educationists in the UK often call them) required for future success and which lie beyond the focus of public examinations

Having participated myself in this pedagogy by establishing small research projects in Years 7 and 8 and leading and managing extended projects in the sixth form, my aim in this study was to probe the distinctive effectiveness, or otherwise, of the research-based pedagogy at the school by examining what the students themselves have to say about it. This was in order to focus on the outcomes of the pedagogy and not primarily its structure or implementation. Thus, I have foregrounded the views of students actually participating in research projects during, or shortly before, the period of my study, using my own observations of research groups at work and my reading of relevant school documentation as background and preparatory material.

I focused in this study on the agency and sense-making of individual students within a particular, emergent institutional philosophy which I saw as essentially social constructivist, as is clear, I think, from the extract from the head teacher's draft document cited above. Thus, the study explored related social and psychological theories of situated learning and communities of practice, with their emphasis on the idea of the real-world engagement and understanding that appears to sit at the heart of the school's pedagogy (see Wenger, 1999: 100).

The overall methodology chosen, that of the single case study, followed from the initial invitation to research. Because of my interest in agency and emergent culture rather than causal links between learning and graded performance, I have conducted a case study which is predominantly qualitative, confining quantitative method to my use of the school's own sixth form questionnaire.

The approach flowed from a critical realist epistemology – the idea that the knowledge and understanding of human beings are strongly influenced by social structures that have emerged from their interactions, but which are also subject to transformation at close

quarters by other human beings expressing their independent agency. Much of the time, in practice, I employed case study methodology intrinsically rather than instrumentally, that is, focusing on "the case" itself for its own inherent qualities, rather than considering it as an exemplar of an established pedagogical theory or tradition, and being led by the evidence throughout, particularly that of the student interviews.

The preliminary research questions employed the term *authentic learning* as a way of neatly explaining what I took to be the chief characteristics of the school's pedagogy, its emphasis on unusually challenging, autonomous and collaborative investigation beyond conventional syllabus-based learning and in contact with real world expertise. However, it emerged from my thinking about these questions that the term lacked effectiveness since it was less familiar than *research-based learning* to both students and staff at the school and was likely to be conflated with the relatively limited account in the empirical literature of mostly US projects also given the title *authentic learning*. Thus, the later version of the questions (below) no longer used the term and focused more fully on students' conceptualisations of their research activities:

> *Main research question*: How do sixth form students conceptualise their learning dispositions, roles and relationships in the research-based learning culture of a single case study school?
>
> *Subsidiary questions*:
>
> 1. How do students describe and theorise about the learning dispositions, roles and relationships emerging from their experience of research-based learning and how can existing learning theory help us to understand them?
> 2. What theories emerge from the data concerning pedagogy and research-based learning in the case study school, and how might these contribute to a broader understanding of similar learning cultures?

1.4. Context: the case study school and research-based learning

1.4.1. The general context

The case study school is an 11-18 selective school for male students (Years 7-11) and male and female students in the sixth form, where a significant proportion of students come from other schools. It is sited in a semi-rural, prosperous location in Kent. Selection at the school follows the Kent Test scheme and established parental choice procedures. In recent years the school has been oversubscribed at both Year 7 and Year 12, and was awarded Outstanding status in the last Ofsted inspection (2013).

1.4.2. The social and political context

At the time of writing, the case study school remains one of 163 grammar schools in England. According to government statistics (Bolton, 2017), this number has declined from 1,300 in 1964 to the present figure, following the issuing of Circular 10/65 which encouraged, but did not insist upon, a move to a fully comprehensive system. This was a move resisted by some county and local authorities, not least in Kent, where Conservative control of county and local government has been traditionally very strong. This resistance, and the reluctance of governments of different political persuasions to abolish selective schools, has resulted in the survival of those that remain. Even the current government's stated wish to lift the ban on new grammars has been shelved following the results of the last general election in June 2017 (see Long, Foster and Roberts, 2017).

Selection at 11 has long been the subject of fierce debate, grammar schools embodying for some a problematic context of social segregation. The 2017 statistics show that grammar schools are less likely to have special educational needs students or students who qualify for free school meals than the average non-selective secondary school, and

a 2008 report (DCSF, 2008) suggested that only 8% of students from the most deprived quartile enter grammar schools, compared to just over 20% in other schools in the local area, reinforcing the view of many that selective schools do not encourage social mobility. However, in terms of racial mix, the 2017 statistics show that grammar schools have a slightly higher than average number of non-white students and appear to be very popular with parents, 37% of grammars in 2014 being full or having more students than their stated capacity compared to 15% of all state secondaries (Bolton, 2017: 4-5).

This study of sixth form students engaged in research inevitably existed against this backdrop. However, it should be noted that, whilst the internal (male) students moving up into the sixth form from lower down in the school had passed the Kent Test, a number of those entering the school from outside (female and male) had entered from something other than a grammar school, purely on the basis of their GCSE results and the school's judgement of their capacity to succeed. According to a draft research report prepared by the school in December, 2015, these students represented a small but significant percentage (17.2%) of the total number of students in Year 12, and 17 students in that cohort were in the bottom socio-economic quintile, suggesting that in that year the case study school's sixth form intake was not one of overwhelming privilege.

Whilst acknowledging that the study exists within a contested educational context, my focus was on the work of students as individuals within this particular setting, facing up to challenges, succeeding and struggling, working on their own or in collaboration with other students, teachers and outsiders. However, where relevant, the study has exposed differences between the culture of the case study school and that of other schools and is reflexive about the conditions under which data were obtained.

1.4.3. Research-based learning in the context of institutional change

When the current head teacher arrived at the school in 2001 there were aspects of the school which he judged to be ineffective, especially in the areas of teaching and learning and achievement, bearing in mind the selective nature of the school. These aspects, together with an unhelpful prevailing professional culture, seemed to call for a rigorous programme of change. As part of this programme, he carried out a doctoral analysis in 2003 of how such a school's culture and susceptibility to change could be exemplified in a case study.

The programme aimed to begin the process of change and arrest the decline using models of school culture and effectiveness developed by Rosenholtz (1989) and others and the idea of 'total quality' and 're-engineering' (see Davies and West-Burnham, 1994). The post of Director of Learning was created to improve the quality of teaching and learning and reinvigorate the processes of performance management and professional development. A stage was reached in 2003, co-incident with the completion of the head teacher's thesis, where it was judged that a position of general effectiveness in terms of culture, teaching and learning and, to some extent, achievement had been attained.

At this point, the head teacher began building on the spontaneous work in the science department developing the notion of *big idea* teaching, in the hope that this emphasis on challenging, ground-breaking projects would spread to other subject areas and take student learning to another level, in line with the institution's responsibilities towards its selective students. The notion quickly spread within the science department, innovative projects springing up in biology and chemistry to match the research work happening in physics, but was much slower to develop in other subjects.

When schools nationwide were invited to re-shape their curricula around new government guidelines (2008), a leadership group at the school developed a set of

attributes, based on national and international models, which would represent those skills and characteristics the school was seeking to develop in its students. As part of this re-shaping, there was further development of the innovation in science and a few other subjects, towards the gradually emerging idea of *research-based learning*, the instigation of humanities and science projects in Key Stage 3 and the History of Ideas programme in Key Stages 4 and 5.

Thus, at the start of this study, in 2015, the idea of *research-based learning* was well-established, though still developing in subjects such as English and the humanities, and students were increasingly being drawn to the school from outside, at least in part because of the open, challenging culture it was perceived as having.

1.5. The organisation of chapters

Following this introductory chapter, I begin a discussion of critical realism and its use in my study. This positioning reflects the way its broad and inclusive ontology underpins my whole approach to what I see, what I hear and the inferences I draw.

Chapter Three is a review of relevant learning theories and empirical research fields. In some ways, this runs counter to my prevailing intention to privilege the voices and conceptualisations of students themselves. However, it is important, at an early stage, to set the context for my later discussion of how my findings from the data support or challenge the theoretical and empirical base, and to make clear both the gaps in knowledge I am attempting to fill and the implications the relevant literature has for my approach. Theory and empirical research are separated in the review, though there are clearly overlaps and concordances between them.

Chapter Four concerns the methodology and methods of my study. Here, I examine my use of case study, my strategies for sampling, data collection and analysis and the rationale behind my use of analytical software and superordinate themes.

In Chapter Five, I begin a lengthy presentation and discussion of the data from the study, concentrating particularly on the student interviews and using superordinate themes that emerge from my preliminary analysis. I begin with the area of real-world professionality, since this is the most frequently occurring theme in the data, then allow the student voice full rein in sections on autonomy, motivation and relationships before broadening the discussion out to the cultural context. The rationale for my use of these themes is explained in full in the introduction to Chapter Five. The intention in this chapter is not to embark on a full-blown interpretation and evaluation of the data, but to hear as much as possible from students, to set their understandings in the context of my own observations, the documentation from the school, interviews with teachers and school leaders and the literature, allowing some patterns and tentative theories to emerge.

Chapter Six is devoted to the emerging synthesis of my findings in Chapter Five, drawing out key issues and problematising the idea of resistance as it applies to learners and institutions. The chapter also considers issues around emergent learning, scaffolding and the broader educational context in which research-based learning sits. It is intended to crystallise some of what the study has to contribute to debates about educational structures, methods and pedagogies.

In the final chapter, based on issues foregrounded in Chapters Five and Six, I set out some key implications for learning theory, for the case study school itself and for other schools already running, or planning, similar programmes of challenging student research. I also address the limitations of this study and the possibilities for future

research, and I end with a personal reflection, a companion piece in some ways to the opening piece in this introduction.

Chapter Two: My conceptual framework: critical realism

The purpose of this section is, ultimately, to show how the ontological position of critical realism informed the research study. To do this, I first explore in broad terms the paradoxical relationship between social structure and human agency and move on to discuss where critical realism fits within the pattern of different conceptions of social structure. I then consider whether critical realism might be said to resolve the paradox of structure and agency through the idea of emergence as it is treated differently by Roy Bhaskar and Margaret Archer. This leads me finally to draw out some key ideas from the critical realist perspective which were useful in beginning to form a framework for my investigation.

2.1. The riddle of structure and agency

The genesis of critical realism came as a rigorous response to the conundrum of the formation and influence of social structures. Margaret Archer calls this conundrum 'the riddle of structure and agency', the fact that social reality and individual agency are mutually constituted, the former having 'no organisational form without us, yet which also forms us as its makers' (Archer, 1998b: 191).

For Bhaskar, the riddle of agency and structure can be expressed as a paradox governing all human activity, society standing to persons as 'something they never make, but that exists only in virtue of their activity' (Bhaskar, 2005: 36-37). Bhaskar sees society and individual human praxis as each possessing a 'dual character', through which society is 'both the ever-present *condition* (material cause) and the continually repro-duced *outcome* of human agency' (Bhaskar, 2005: 37, original emphases).

Owing to this duality identified by Bhaskar, and since social structure is 'both medium and product', it can be seen, variously, as liberating and limiting individual thought and

action, as ‘enabling as well as constraining’ (Manicas, 1998: 318). Porpora, considering specifically the role structures at play in social situations, sees this enabling/constraining quality as manifest in the ‘structural relationships and….various, often conflicting interests they generate’ which form ‘both the material conditions motivating action and the intended and unintended consequences of such action’ (Porpora,1998: 344).

To understand the nature of this riddle, paradox or duality (and therefore the foundations of critical realism), we must consider the two ontologies at opposite extremes of the continuum of positions on social structure. Sayer delineates these ontologies in terms of a question: ‘….are social processes to be accounted for by social structures, such as class structures, of which individuals are merely bearers, or by the conscious activity of individuals and groups…?’ (Sayer, 1984: 79).

2.2. Types of social structure and where critical realism ‘fits’

As an attempt to answer Sayer’s question, and perhaps find a third way, it is instructive to examine Porpora’s useful delineation of four types or categories of social structure:

1. ‘Patterns of aggregate behaviour that are stable over time’
2. ‘Lawlike regularities that govern the behaviour of social facts’
3. ‘Systems of human relationships among social positions’
4. ‘Collective rules and resources that structure behaviour’

(Porpora, 1998: 339)

Of these, 1 and 4 represent the idea of a macro-structure defined by different kinds of individual micro-behaviour. They are thus to be identified with voluntaristic, individualist and reductionist viewpoints which have as their focus individual agency as the sole motive force in society. As Porpora suggests, this would seem to ignore significant societal effects such as those of ‘deindustrialisation, power and economic

crisis' (ibid: 340). Bhaskar succinctly agrees: 'Societies are irreducible to people' (Bhaskar, 1998: 206).

Porpora's second type or category of social structure, though, represents precisely the opposite view from that of 1 and 4 and is associated with holistic, deterministic and structural approaches which tend towards the reification of social structure and see it as operating 'mechanically and naturalistically over the heads of individual actors' (Porpora, 1998: 342) through what Archer calls 'sociological imperialism' (Archer, 2000: 253).

This leaves us with Porpora's third type or category, 'systems of human relationships among social positions', which is the structure closest to the position of critical realism, a notion of social life which embraces the paradox of structure and agency. Bhaskar articulates this embrace in a passage which is worth quoting in full: 'Society is not the unconditioned creation of human agency (voluntarism), but neither does it exist independently of it (reification). And individual action neither completely determines (individualism) nor is completely determined by (determinism) social forms' (Bhaskar, 1982: 286).

Archer attempts a definition of critical realism which builds on Bhaskar's riddling offering. It is an ontology which, she writes, provides an 'explanatory framework' in an 'open system', acknowledging and incorporating, first, '*pre-existent structures*' which act as 'generative mechanisms', second, their 'interplay with other objects possessing causal powers' and, third, 'non-predictable, but none the less explicable *outcomes* arising from the interactions between the above' (Archer, 1998c: 377, original emphases).

2.3. Critical realism: the answer to the riddle?

Archer's definition above implies, but does not fully explicate, a depth ontology of social structuring, with 'successive layers emerging from those below' (Priestley, 2011: 228). In this ontology, social forms are created by other, usually smaller, component forms and individuals and in turn go on to form social entities that are larger still. This process of so-called 'emergence' is one of the central tenets of the critical realist standpoint. Through emergence, 'each successive stratum possesses properties not possessed by the individual entities that come together to form the emergent whole' (Priestley, 2011: 228), and thus has its own, independent causal force, potential or actual. Priestley gives the example of a subject department in a school which 'will possess certain emergent properties….not possessed by the individuals within the group, by dint of the relationships that bind it together' (ibid: 228).

However, if the stratification of society envisaged here were all, critical realism would be no less constraining than deterministic holism or reductionism (just rather more elaborate). What provides the liberating, critical element is the relational interplay between the layers, and the possibilities for change this brings. Thus, 'the emergentist approach….sees *both* embodied human individuals *and* social structures – and indeed cultural constructs – as causally effective, with all three interacting in the causation of social events' (Elder-Vass, 2008: 282).

Bhaskar's version of the emergentist approach acknowledges a similar relational quality to social causation, seeing the world as 'structured, differentiated and changing' (Bhaskar, 2011: 2). However, Bhaskar is sufficiently a determinist to assert the primacy of existing social structures: 'pre-existence of social forms will be seen to entail a *transformational* model of social activity' (Bhaskar, 1998: 206), such that 'it is no longer true to say that agents create society. Rather one must say: they reproduce or transform it' (Bhaskar, 2005: 36). This process of reproduction and transformation is central to

Bhaskar's vision; it is a process which he sees as ubiquitous, quotidian and perpetual, as 'the social world is reproduced or transformed in daily life' (Bhaskar, 2011: 3).

Archer's vision concentrates more on process than structure. It has much in common with Bhaskar's ontology, but also one small but significant difference. For Archer, society is in what we might call 'ordered flux', a movement whereby change is engendered through social relations in a process she calls 'morphogenesis', leading to the coalescence of social structures which then, as with Bhaskar, come to have a stable causal effect of their own in a process she calls 'morphostasis' (Archer, 1995: 166).

This process appears more fluid than Bhaskar's reproduction-transformation model and carefully establishes 'a centrist position that does not privilege the individual over society or vice versa' (Priestley, 2011: 228). However, the resultant theoretical position is largely similar, save for one important distinction. For Bhaskar, the interface between existing structures and individual agency is through what he calls 'the position-practice system' (Bhaskar, 2005: 44) by which human actors can affect social systems. Archer, though, asserting a more liberal and dynamic position, believes the agential possibilities must be allowed to extend to 'problematic (or felicitous) situations or contexts which are not tightly associated with specific normative expectations' (Archer, 1998c: 371) and which enable individuals to think outside the reproduction-transformation box. This significant codicil to Bhaskar's critical realism is important when considering human responses in a complex social context such as that of a school.

Both Archer and Bhaskar, however, would concur with the importance of what Archer refers to as 'analytical dualism'. Taking the duality of Bhaskar's paradoxical condition/outcome view of social structure, analytical dualism is a methodological stance which axiomatically holds analysis of effects of social processes apart from

analysis of effects of individual agency, yet it does so precisely in order more precisely to 'link the "parts" and the "people"' (Archer, 2000: 1) and judge 'the relative causal weight of culture, structure and agency in any given social situation' (Priestley, 2011: 229).

2.4. Critical Realism: a framework for investigation

Analytical dualism is one of several key concepts and approaches deriving from critical realism that provide a firm foundation for investigative case study. Thus, Bhaskar recommends it as providing 'an ontological, epistemological and methodological framework for everyone working on a research project in the social sciences' (Bhaskar, 2010: 78). Archer supplies more detail here: in the dynamic interplay between the strata existing in educational as much as in other social environments, it is important to investigate, from a critical realist perspective, '*whose* conceptual shifts are responsible for *which* structural changes, *when*, *where* and under *what* conditions' (Archer, 1998c: 366, original emphases). This investigation was important in my study in terms of how the stratum represented by the distinctive pedagogy of the school had coalesced through the intervention of both those in a position of institutional power – teachers and senior leaders – and those students involved in research.

It was also important, however, to accept that the very 'reproduction' of the causative structural effects of the school's pedagogic programme was, for some if not all students, in itself an 'achievement' (Bhaskar, 2005: 39). There is clearly a balance to be struck here; students were already reaching for approaches to learning that were challenging, but their ability to adapt and change the existing structures, procedures and methods within which they had been working, what Archer calls the 'creative re-design' of the social environment (Archer, 2000: 308), needed also to be identified and celebrated.

Nevertheless, questions had to be asked during the study about any tensions in the way the morphostatic and morphogenetic elements played out in context. Was there, for example, a positive commitment amongst students and staff, despite 'unequal power relations', to 'endorse the practice' of research freedoms, both within the necessarily separate groups of students and staff and within the mixed groupings often thrown up by research-based learning praxis (Elder-Vass, 2008, 290-292)?

In research-based learning situations, it would be surprising if students had not taken, or been given, identifiable roles. Critical realism allows us to appreciate that these roles themselves, as emergent entities, will have had causal effects on the students acting as 'role incumbents' (Archer, 2000: 283), but that students themselves, through their own personal beliefs which 'mediate between social institution and individual behaviour' (Elder-Vass, 2008: 291) will have adapted and transformed their roles and not merely reproduced them. This, of course, presupposes an institution which encourages 'strategic uses of….freedoms' without 'contextual constraints' (Archer, 1998b: 203).

Evidence of whether research participants feel empowered or constrained by the particular research context may well be revealed in their responses at interview. Here, as Archer reminds us, it is very important, under the methodology of analytical dualism, to 'take what people say seriously….even when we are sure that they mean something different,' since 'our meanings in these circumstances indicate a good deal about our Socio-Cultural attitudes towards the cultural system – whether we feel bound to it or constrained by it' (Archer, 1998a: 534). In other words, the very interview process itself can reveal the structure-agency tensions that govern all social interaction from a critical realist perspective.

Finally, critical realism tells us that society is layered, complex, dynamic and in flux and that investigations in a case study should recognise that all explanations must, of necessity, be context-specific and tied to the relational dynamics of a stratified and shifting local pattern. This recognition feeds directly into debates around generalisation which I cover later in my analysis of case study itself.

Chapter Three: Literature Review

3.1. Introduction

The focal point of this critical case study is a form of pedagogy which the case study school has based around the idea of student research. At its heart, it is a constructivist pedagogy which has, itself, been developed and promoted by what could be termed a constructivist process of leadership and management, a process that has taken what works and what excites in the work of the science department of the school and allowed it to evolve organically into a more integral, school-wide approach involving a significant number of other departments, amongst them Geography, History, English, Music and Design.

Through my initial understanding of the school's approach, I identified a number of variants of the constructivist idea as being of importance – situated learning (and legitimate peripheral participation in communities of practice), transformative learning, autonomous learning, project-based learning and authentic learning. More specifically, in his interview with me and in a draft written exposition of the pedagogical principles of the school, the head teacher refers to the work of theorists and proselytisers of learning approaches related to, or deriving from, constructivist and social constructivist theories – Vygotsky, Feuerstein and Mitra.

This literature review, therefore, will begin by concentrating on constructivist and social constructivist ideas, drawing on the work of key theorists – Piaget, Vygotsky, Bruner, Wenger and Mezirow amongst others – and will attempt to set them briefly in the broader historically-mediated, pedagogical context. The aim is to provide a theoretical basis for describing and reflecting upon the school's research-based approach, whilst being aware of the importance of what the research data itself will reveal, especially in

terms of student conceptualisations. The review will then go on to consider the range of relevant empirical research on applied constructivist approaches in order to see more clearly where this research study can make an original contribution to knowledge.

3.2. Relevant theories of learning

3.2.1. Constructivism: Jean Piaget

The focus of constructivism is primarily on the individual's 'mental construction', whereby 'new information is built into and added onto an individual's current structure of knowledge, understanding and skills' (Pritchard, 2009: 17). Pritchard's definition steers closely to the ideas of Jean Piaget, an unavoidable, seminal figure in research into cognition, learning and education and someone who is 'generally regarded as a foundational figure by many constructivists' (Phillips, 1995: 6).

Piaget's notion of the tension between 'assimilation' (absorbing new information into an existing framework of understanding) and 'accommodation' (the need to change that framework where it no longer satisfies what the developing senses are telling it) takes us to the heart of what it is to construct new knowledge (Piaget, 1954: 353). Despite a natural resistance to accommodation, Piaget believed that the human individual is constantly striving to find coherence in her view of the world, but is always challenged by new, potentially disruptive insights, a version of the reproduction/transformation dialectics of critical realist theory in terms of individual mental development. For Piaget, this sought-for coherence is expressed in the different 'stages' of mental development which have come to define his work (Piaget, 1971: 36-37).

Piaget's approach focuses primarily, but not exclusively, on individual sense-making. However, another, quite different approach sees learning as irredeemably rooted in our social life. Thus, 'knowing….can be seen as a function of our shared world rather than

as something built up by the solitary self' (Smith, 1997: 131) and as 'socially constructed and accordingly….a social process' (Candy, 1988: 74), the contrary view leading potentially to solipsism, to 'arrogance or rampant individualism' (Potts, 1988: 149).

3.2.2. Social constructivism: Lev Vygotsky

This approach has come to be called 'social constructivism', a set of ideas built around progression through, rather than despite, social intercourse and on the powerful influence of language, culture and pedagogy. Many of these ideas have their starting-point in the work of Russian theorist Lev Vygotsky.

Vygotsky's work has been cited by the case study school as influential, largely through the concepts of 'scaffolding', a term intimately related to Vygotsky's work, but which was coined by Jerome Bruner (Wood, Bruner and Ross, 1976: 90), and the 'zone of proximal development'. The school also relates these ideas to those of Israeli cognitive psychologist Reuven Feuerstein and his notion of 'mediated learning', the deliberate accelerative and enriching effect of the challenging presence of a knowledgeable other (see Kozulin and Presseisen, 1995: 67).

Vygotsky's debt to Piaget is shown clearly in parts of his 1986 text, *Thought and Language*, especially in the idea that concept-formation 'can be accomplished only when the child's mental development itself has reached the requisite level' (Vygotsky, 1986: 149). However, much of Vygotsky's work elsewhere is more critical of Piaget, suggesting, for example, that in his writing maturation is 'viewed as a precondition of learning but never the result of it' (Vygotsky, 1978: 80), an idea he develops more fully in *Thought and Language*: Piaget's scheme, according to Vygotsky, insists that 'instruction remains an extraneous factor' (Vygotsky, 1986: 176) and leads to a false distinction between 'spontaneous' and 'nonspontaneous' concept-formation, whereas,

for Vygotsky, these are 'parts of a single process' (ibid: 157) in which pedagogy comes to have more force and importance than in Piaget's work. In this theoretical shift, 'the only "good learning" is that which is in advance of development' (Vygotsky, 1978: 89), urged on by the challenging support provided by teachers and other more advanced learners, an idea he would develop further in the theory of the 'zone of proximal development' (ZPD).

Vygotsky defines this zone as 'the distance between the actual development level….and the level of potential development….under adult guidance or in collaboration with more capable peers' (Vygotsky, 1978: 86). In the same passage, he goes on to write that the 'actual' level (here associated with Piaget's stage theory) 'characterizes mental development retrospectively', the ZPD representing development viewed 'prospectively'. Thus, Vygotsky's scheme is about 'the future not the past' (Vygotsky, 1986: 189), about an idea that was an important critical focal point in this study – the extension of students' independent creative imaginations, capabilities and achievements through the intervention of skilled and more experienced others. It is thus fundamentally about the collaborative process by which 'the child can do in cooperation today what he can do alone tomorrow' (ibid: 188).

For Vygotsky, the nature of the role of teacher or knowledgeable peer is to seed new ideas and encourage the formation of concepts 'formed by the student himself' (Vygotsky, 1986: 152), rather than rely on the 'empty verbalism' of 'direct teaching of concepts' (ibid: 150). The relationship between student and teacher thus implies a strong social component to learning, something confirmed by Vygotsky's unequivocal statement, in *Mind in Society*, that 'human learning presupposes a specific social nature and a process by which children grow into the intellectual life of those around them'

(Vygotsky, 1978: 88). The result is the development of 'culturally organized, specifically human, psychological functions' (ibid: 90).

Yet interpretation of what Vygotsky writes on this subject is not completely straightforward. We might perhaps characterise his approach as being about "context" and "contest": at some moments, he appears to support peer-to-peer collaboration when he writes unequivocally about the importance of a culturally cooperative environment (Vygotsky, 1978: 90), but at others he writes specifically about the importance of the challenge provided through contact with 'more capable' peers (Vygotsky, 1978: 86) as surrogate teachers in the ZPD. This need not, of course, be ambiguous. We might use a horticultural analogy to clarify the approach, the context of peer cooperation being the soil in which human learning must be planted and the contest of exposure to the challenge of teachers and more able peers being the light, air and water with which intellectual development is fed. Both are vital, Vygotsky seems to imply, and both were certainly in evidence in the group project approach of much of the research work at the case study school, led by both teachers and more experienced peers.

This approach, of social learning intensified by challenge, has come to be known as 'scaffolding', a term actually coined by Jerome Bruner. It can be defined, in its original form, as 'the support an experienced adult – a parent or teacher, for example – provides to assist the natural development of a younger, less experienced learner' (Moore, 2012: 19). One might, of course, add "or more experienced peer" to the list above. 'In its original form' is important here, since the approach has, it might be suggested, been re-contextualised by the instrumental logic of a constrained and constraining syllabus- and examination-based system (see Moore's explication of this historical transmogrification – Moore, 2012: 19).

Significantly for this study, Vygotsky sees this process as particularly important for adolescents, whose development as learners is 'prompted not from within but from without, by the social milieu' (Vygotsky, 1986: 108). For a member of this group, he sees it as a binding responsibility for the 'cultural, professional, and civic world of adults' to present 'new demands on him (sic)', without which the adolescent's intellect will remain unstimulated, her thinking failing to 'reach the highest stages' (ibid: 108).

3.2.3. Scaffolding and the role of culture: Jerome Bruner

As mentioned above, the initial use of the term *scaffolding* comes in the work of Jerome Bruner, first surfacing in Wood et al.'s analysis of the effects of tutoring from a psychological perspective (see Wood et al., 1976). The scaffolding method is seen here as enabling 'a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his (sic) unassisted efforts' (Wood et al., 1976: 90). The method is couched in overtly constructivist/social constructivist terms, emphasising that 'well-executed scaffolding begins by luring the child into actions that produce recognizable-for-him (sic) solutions' (ibid: 96), and making it clear that, for the learner, 'comprehension of the solution must precede production', which Wood et al. gloss as meaning that the learner 'must be able to recognize a solution to….problems before he (sic) is himself able to produce the steps leading to it without assistance' (ibid: 90). The duty for the teacher (or more experienced adult or peer) is to develop the 'tutor's theory of the learner', knowing what the learner already knows and moving her forward in challenging, but appropriate, ways through 'transactional' methods (ibid: 97).

Wood et al. (1976) outline six key features of the scaffolding process, instantly recognisable as in tune with Piagetian and Vygotskyan ideas, and, again, with the approach of teachers and leaders at the case study school – the importance of generating

‘interest’ and ‘adherence’, of subtly maintaining the student’s motivation ‘in the field’ so that she feels it ‘worthwhile….to risk a next step’, of keeping ‘frustration’ at bay and ‘demonstrating’ or ‘modelling’ solutions through idealised versions of what the student should aim to achieve (ibid: 98).

However, two of the elements of the process strike the 21st Century reader as unusual for an avowedly constructivist/social constructivist text. One is the ‘reduction in degrees of freedom’, in which the task is simplified by ‘reducing the number of constituent acts required to reach the solution’ (ibid: 98). This emphasis on restriction and constraint seems to run counter to the facilitative encouragement and liberation that should mark the use of genuine scaffolding. Similarly, marking scaffolded work so as to point to ‘the discrepancy between what the child has produced and what he (sic) would recognize as a correct production’ (ibid: 98) appears ill-at-ease with notions of positive encouragement and the recognition of the validity of individual meaning-making that characterise constructivist/social constructivist theory.

This freedom-constraint dichotomy poses interesting questions in terms of the analysis and evaluation of data from the case study, since the school’s pedagogic stance appeared from the data to be one in which simplification and constraint militated against the interests of the students and were openly disavowed. It will, thus, be important to return to these ideas later, especially in consideration of the concepts of legitimacy and peripherality in the theories of Jean Lave and Etienne Wenger (see, for example, Lave and Wenger, 1991).

Despite the somewhat dissonant effect of the two elements of the scaffolding process described above, it is perhaps significant that Bruner himself takes a rather different stance in his retrospective 1996 Preface to *The Culture of Education*. Here, the emphasis

is entirely on ‘discovery’ and on the teacher as a ‘guide to understanding, someone who helps you discover on your own’ (Bruner, 1996: XII). Through this idea he exemplifies his notion of learning as culturally embedded, an open, discovery approach presupposing a broader educational culture in tune with it, since ‘what we resolve to do in school only makes sense in the broader context of what the society intends to accomplish through its educational investment in the young’ (ibid: IX). This idea contrasts with a point in the draft document of the head teacher of the case study school that research-driven pedagogy in the school runs counter to the prevailing examination- and testing-driven culture in education more generally.

Naturally, a pedagogy dissonant with the goals of education in general must create its own culture-in-miniature, a culture which Bruner suggests ought to be cast in an environment of ‘mutual sharing of knowledge and ideas, mutual aid in mastering material, division of labor and exchange of roles, opportunity to reflect on the group's activities’, such that the school becomes both ‘an exercise in consciousness raising about the possibilities of communal mental activity, and….a means for acquiring knowledge and skill’ (Bruner, 1996: XV).

3.2.4. Situated Learning and communities of practice

Bruner’s emphasis on the social and cultural in learning, and on the need for mutuality, is strongly reflected in the ideas behind the notion of *situated learning*, a movement emanating from psychosocial research in the 1980s which gained strength in the 1990s and whose influence can still be felt in active and collaborative approaches to learning in the 21st Century. Thus, Etienne Wenger emphasises that learning and knowledge-acquisition are fundamentally social, active and participatory, so that ‘promising’ ways of engaging students in ‘meaningful practices’ involve them in ‘actions, discussions and

reflections that make a difference to the communities that they value' (Wenger, 2009: 15).

One of the most succinct and frequently cited explanations of situated learning theory is that by Brown, J.S., Collins and Duguid (1989). The authors here point out that contemporary psychosocial research into learning suggests that the 'separation between knowing and doing' is a false, but powerfully resilient notion associated with more traditional, didactic approaches to instruction (Brown, J.S. et al., 1989: 32). They argue that cognition and learning are 'fundamentally situated' (ibid: 32), that is, deeply rooted in particular contexts of working and 'distributed', so that knowledge is 'coded by and connected to the activity and environment in which it is developed', its 'component parts' – the physical and conceptual tools of learning – existing both 'in the mind' and 'in the world' (ibid: 36).

The problem with school, according to the authors, is that this environment acts as any other in enculturing students, such that the learning that happens there, even if it is in theory modelled on 'real world' activity, ends up as 'ersatz', and as 'hermetically sealed within the self-confirming culture of the school' (ibid: 34). The answer to this problem, they write, is to embed learning in the culture and methodologies of particular domains, so that students undergo a form of 'cognitive apprenticeship' which makes 'deliberate use of the social and physical context' (ibid: 32), and to employ an empowering form of scaffolding which builds students' confidence by moving them to ever more confident autonomous stages where they begin to 'participate consciously in the culture', and to form self-generated conceptual understandings (ibid: 39). The idea is very close to the theory of 'legitimate peripheral participation' developed by Lave and Wenger (1991)

through their study of first- and developing-world working communities and schools, which is considered below.

Not everyone in broad sympathy with these ideas, however, believes it is practically possible to embed domain-specific situated learning in schools. Brown, A., Ash, Rutherford, Nakagawa, Gordon and Campione, for example, find the idea that students can be 'enculturated into the cultures of mathematicians, historians, and literary critics' to be 'romantic' (Brown, A. et al., 1989: 189) and contest the idea that creating a 'community of scholars' need necessarily result in an 'ersatz', or fake, experience. They posit the idea of a culture of 'distributed expertise', in which students take on 'the role of active researchers and teachers, monitoring their own progress and that of others when they adopt the role of constructive critics' (ibid: 203). In other words, these authors suggest that modelling of genuinely autonomous, collaborative learning can be set up in schools without the risk of diluting the freedom or validity of the experience. In terms of the 'real world', they argue, using science as an example, 'the best we can do is to avoid obvious discontinuity with the cultures of practicing scientists' (ibid: 222).

This disagreement among friends may appear to highlight a rather insignificant difference, yet it is a crucial one for this study, since the case study school would appear to have fully espoused the idea of allowing students to initiate and develop roles as 'real' scientists, historians, and so on. The important question to ask is whether the experiences of the students have been those of actual disciplinary traditions, or whether they have remained 'sealed' in a school culture which, to use Lave and Wenger's terminology, allows peripherality but not true participation.

Legitimate peripheral participation

The whole argument over whether schools can facilitate learning which is genuinely integrative with domains of practice in the real world is, to some extent, resolved in the idea of *communities of practice* and in the concept of *legitimate peripheral participation* (LPP). The latter term is first used in the title of Lave and Wenger's 1991 text, which goes on to see it as an inevitable part of the idea of situated learning, a 'process by which newcomers become part of a community of practice', a process which, as the authors put it, rescues 'the idea of apprenticeship', extending it to refer to cognition and even life itself (Lave and Wenger, 1991: 29).

Epistemologically, LPP is founded on a relational conception of learning that is close to critical realism, participation being 'always based on situated negotiation and renegotiation of meaning' which 'implies that understanding and experience are in constant interaction, indeed are mutually constitutive' (ibid: 51-52), taking place as they do 'in a social world, dialectically constituted in social practices that are in the process of reproduction, transformation and change' (ibid: 123). For this reason, it is important that neophyte learners in a particular domain are able both to engage in an existing practice and to take ownership of a personal 'stake in its development', that, whilst their involvement is necessarily peripheral, it should also be legitimate and participatory (ibid: 115), with an emerging balance between reproduction and (modest) transformation that embodies Bhaskar's critical realism (see Bhaskar, 2005: 27-29).

In practical terms, LPP is based on the centrality of a 'learning curriculum' rather than a 'teaching curriculum', the former situating learning in the practice, resources and social relations of a community, rather than seeing it as 'mediated through an instructor's participation' (Lave and Wenger, 1991: 97), such that the learner learns '*to* talk' rather than learning '*from* talk' (ibid: 109, original emphases). Lave and Wenger see the control

wielded by ‘didactic caretakers’ of the teaching curriculum as a form of sequestration entirely in keeping with the ‘commoditization of learning’, enforcing a dissonance between ‘the use and exchange values of the outcome of learning, which manifests itself in conflicts between learning to know and learning to display knowledge for evaluation’ (ibid: 112). The example they give of these distinctions is entirely apt for this study, since it involves the difference between American high school physics students participating only in ‘the reproduction of the high school itself….of schooled adults’, rather than in the community of ‘professional physicists’. The example is telling, since, in the case study school, much of the initial growth of real-world, research-based pedagogy came from work in the physics department.

The ideas behind situated learning, communities of practice and legitimate peripheral participation are explicated, developed and theorised more fully in Etienne Wenger’s 1999 text, which, like Lave and Wenger’s earlier text, follows a critical realist perspective in seeing learning communities as fluid, emergent social structures embodying practice ‘at once highly perturbable and highly resilient’ (Wenger, 1999: 96) and incorporating neophyte learners able to contribute to a ‘renegotiation of the enterprise’ (ibid: 97), as well as following the given precepts of the existing community.

In this ‘emergent’ school learning environment, in which teaching becomes ‘one of its many structuring resources’, the crucial question is how to allow the reified and planned (which even Wenger allows are an unavoidable part of education policy and practice) to interact positively with the emergent resourcefulness of learners, such that they ‘inform each other’. Only if we can do this will we avoid the situation where (in Wenger’s memorable phrase) ‘school learning is just learning school’ (ibid: 267).

This brings the argument for LPP to a key moment. Wenger proposes that teachers and learners in all environments where teaching and learning happen need to 'broaden the traditional connotations of the concept of apprenticeship', such that it becomes emancipated from the conventional 'master/student or mentor/mentee' relationship into 'one of changing participation and identity….in a community of practice' (ibid: 11). Such an apprenticeship model, Wenger writes, 'takes place not so much through the reification of a curriculum as through modified forms of participation that are structured to open the practice to nonmembers' (here, 'nonmembers' refers to learners in all learning environments, family-, work- and school-based, who begin their learning outside the community of practice, in effect, looking in).

The key question here, of course, is how this differs from the point made by Brown, A. et al. (1989) that all that schools can hope to achieve is a model of autonomy and collaboration, whilst avoiding discontinuity with real world practice. This is, to some extent, no doubt, a matter of splitting hairs, but, as discussed above, they are important hairs to split for this study. Wenger's answer to the question is to suggest that peripherality and participation must act together. If students are thrown in the deep end of full-on domain practice, in other words given participation without peripherality, they will tend to be over-challenged and driven into a retreat from learning. On the other hand, if they are kept at too safe a distance from the community of practice and not allowed to contribute their own voices to it, in other words granted peripherality but not participation, their learning will ossify.

What is needed, Wenger asserts, is 'an approximation of full participation that gives exposure to actual practice', for example through 'lessened intensity, lessened risk, special assistance, lessened cost of error, close supervision'. This seems to bring the

argument once more back to modelling, but Wenger insists 'there is a big difference between a lesson that is *about* the practice but takes place outside of it, and explanations and stories that are *part of* the practice and take place within it', such that neophytes can be 'granted enough legitimacy to be treated as potential members (of the community of practice)' (ibid: 100).

The goal for learners and teachers in the situated curriculum is neatly summed up in the idea of the 'expert student' (Sternberg, 2003: 5). In this notion, students are nurtured in a 'culture of expert practice' (Collins et al., 1989: 488) achieved through 'key aspects of expertise', the 'cognitive and metacognitive strategies and processes', which are generally made 'invisible to students' in favour of 'low-level sub-skills or abstract conceptual and factual knowledge' (ibid: 454-455) and 'inert' knowledge deriving from a concentration on preparation for tests (Brown and Palincsar, 1989: 394).

If, tentatively speaking, we might assert that research-based pedagogy appears to be founded on a situated approach, leading in theory to legitimised peripheral student participation, and that its aim might be to promote the expertise of genuine disciplinary engagement, then Wenger's 'itinerary of transformative experiences' might be the ultimate goal. The word 'transformative' that sits at the heart of this phrase takes us to a theory of learning that looks specifically at the effects of participatory learning, not merely on students' success as learners, but on their identities as people.

3.2.5. Transformative learning

The context of transformative learning is that of adult and lifelong learning, and one of its prime movers is undoubtedly Jack Mezirow, whose writing in the early years of the 21st Century and beyond has attracted much critical attention and debate, at least in part because its central ideas have spread beyond its andragogic context.

Mezirow defines the focus of Transformation Theory as 'how we learn to negotiate and act on our own purposes, values, feelings, and meanings rather than those we have uncritically assimilated from others' and goes on to define its goal as gaining 'greater control over our lives as socially responsible, clear-thinking decision makers' (Mezirow, 2000: 8). This ambitious set of theoretical principles and goals clearly places strong emphasis on the promotion of agency and a corresponding independence of mind. As such, it contrasts somewhat with other approaches to Transformation Theory, such as that articulated by Dirkx (see Dirkx and Mezirow, 2006), where the emphasis is more on psychoanalytical or psychotherapeutic approaches to transformative *change*, in which unconscious feelings and motives are allowed to surface and become accommodated, rather than the conative aspects of transformative *learning*.

In critical realist terms, the focus in Mezirow's work is very much on transformation rather than reproduction, on morphogenesis rather than morphostasis, though largely within the frame of the individual rather than society. It differs from the kind of transformation envisaged in situated learning in foregrounding personal change rather than the renegotiation of meaning through initial acquiescence in membership of a community of practice, as envisaged, for example, by Etienne Wenger (see above).

The focus and goals of transformative learning can appear somewhat ill-defined, but Mezirow attempts to flesh them out a little through the idea of the necessary disruptions in 'frames of reference' (ibid: 16), the cognitive and affective dimensions by which our world is shaped, and which, Mezirow acknowledges, can confer 'stability' and identity' (ibid: 18). These disruptions, according to Mezirow, are of two kinds: 'epochal' and 'cumulative', epochal denoting 'sudden major reorientations in habit of mind' and

cumulative ‘a progressive sequence of insights resulting in changes in point of view and leading to a transformation in habit of mind’ (Mezirow, 2009: 94).

This second, progressive, form of transformation is, perhaps inevitably, more common and readily accepted than the sudden shift of the epochal moment, the epiphany. Thus, Kegan sees the movement as a gradual one, from being ‘had by’ knowledge to ‘having it’ (Kegan, 2000: 54), and West identifies it as ‘a process rather than a point of arrival’ (West, 2014: 177), one which Illeris identifies specifically with adolescence, a period in which transformative learning ‘becomes by degree the means of development and learning concerning the various elements of the identity, at first through very unsteady trials but gradually by means of more consistent thinking and behaving’ (Illeris, 2014: 159).

In closing this section of the literature review on learning theory, two separate strands become clear – the constructivist approach to learning which concentrates on the intense personal experience of the learner as she develops in her own terms and the social constructivist idea of the learner continuously growing through social, situated contexts and communities. Each of these inevitably comes to have an importance in my analysis of how students conceptualised their learning in this study, as did the subtle combinations and contradistinctions of the two approaches.

3.3. Relevant empirical studies into applied constructivist approaches to learning

If the above theoretical background has provided a lens through which to see more clearly what might be happening in the study, then it is equally important to consider the literature focusing on empirical investigations of the nature and success of constructivist

learning approaches and schemes undertaken in relevant contexts. This is for two reasons – to add a substantive understanding of approaches in line with that of the case study school and to reveal more clearly where there are gaps in knowledge and understanding which this study might look to close.

Three constructivist approaches suggested themselves as being particularly relevant to the work at the case study school: *problem- or project-based learning*, *autonomous learning* and *authentic learning*, representing as they do the methodology, agency and real world relevance which the school's research-based learning appears to be aiming to employ and achieve.

3.3.1. Problem- and project-based learning (PBL)

Before considering empirical studies of learning in the first of these categories, it is important to say that there appears to be no substantial difference between the two widely used terms, *problem-based learning* and *project-based learning*, although clearly the first begins with an aim (to solve a problem), the second with a philosophy or method. Most writers proceed without considering the difference, actively promoting extended, collaborative methods in problem-solving or proclaiming the core desirability of a problem or inquiry question in project learning (see, for example, Blumenfeld, Soloway, Marx, Krajcik, Guzdial and Palincsar, 1991: 371; Wurdinger, Haar, Hugg and Bezan, 2007: 151), the elision between the two being further strengthened by the tendency to abbreviate both to "PBL". For these reasons, this review proposes to consider the two approaches as substantially the same, despite the findings of my own small, unpublished empirical study of project-based learning which questioned the absolute necessity for projects (particularly those in the humanities) to be driven by problems or questions (Jones, 2014: 19).

Substantive studies or meta-studies of problem- and project-based learning have illuminated four strongly recurring areas: difficulties experienced by both students and teachers in adopting new roles, the academic achievement levels of those students pursuing PBL, improvements (or otherwise) in learning performance skills as a result of PBL and the efficacy of collaborative learning. A good many of these studies derive from the US, a reflection of the longevity of these approaches there and perhaps of the fact that they have been seen as part of student re-engagement strategies designed to combat perceived declines in educational standards in urban high schools (see, for example, Steinberg, 1998; Geier, Blumenfeld, Marx, Krajcik, Fishman, Soloway and Clay-Chambers, 2008; Ravitz, 2008). A corresponding critical interest in the UK and elsewhere is not fully evident until the late 1990s, with the publication of Jo Boaler's work on PBL in Mathematics (Boaler, 1997, 1999). Thus, whilst it is important and relevant to take account of studies from the US with respect to the four areas identified above, it is equally important to acknowledge that recent PBL programmes in the UK might well merit further study.

Difficulties experienced by students and teachers

For students, as Sungur, Tekkaya and Geben discovered in their comparative study of traditionally-designed and non-traditionally-designed curricula for sixteen-year-olds in the US, it is 'difficult to deal with….unknowns' in the liberated environment of PBL (Sungur et al., 2006: 158). Similarly, Hmelo-Silver, in her meta-analysis of psychological studies of students undertaking PBL, describes a necessary process of 'grappling with uncertainty' (Hmelo-Silver, 2004: 257).

For teachers interacting with students in PBL, as several writers point out, the challenge is the change from 'expert' to 'advisor/facilitator' and 'resource provider and

participant' (Newell, 2006: 5). Thus, Blumenfeld et al., in their meta-study of a range of PBL programmes in the US from a psychological perspective, write about the seismic shift needed in teachers' approaches, from thinking about 'knowledge transmission' *to* students, to thinking about 'knowledge transformation' *by* students (Blumenfeld et al., 1991: 381). In this transformational mode, as Gallagher, Stepien, Sher and Workman point out in their meta-study of PBL in science classrooms in the US, evidence shows that teachers need to think about allowing students the freedom to become creative 'problem finders' as well as problem solvers (Gallagher et al., 1995: 139), about becoming 'metacognitive coaches' (ibid: 137) who can encourage and develop a broader and deeper understanding of the learning process itself. This evidence is supported by the small-scale case study of Krajcik et al. which highlights the effectiveness of 'tactical' (in terms of fine-tuning) and 'strategic' (in terms of overall direction) metacognition (Krajcik et al., 1998: 346), even though, as the writers warn, the growth in inquiry skills, from their study, is not 'smooth, uniform or linear' (ibid: 349).

Academic achievement and learning performance skills

Several studies have incorporated a consideration of the academic achievement and performance skill levels of students in their analysis of PBL. In terms of the former, the evidence seems unclear. Sungur et al. claim that the 'experimental' (PBL) group in their study attained higher academic scores in biological science both immediately after the relevant project work had finished and in a later post-test (Sungur et al., 2006: 158). In a very similar study, Boaler, in a rare piece of research carried out in the UK in which mathematics students of similar ability but in very different learning environments were tracked through to GCSE from Year 9, writes that the examination results of the PBL-influenced students were significantly higher than those of the traditionally-taught

students, especially at the top end (Boaler, 1999: 4). However, others are less persuaded of the worth of PBL if judged by academic results alone. Jerzembek and Murphy, for example, in their meta-study of empirical research into PBL with school-aged children in the US, argue that the evidence of the academic effectiveness of PBL is ambiguous, one study finding 'no significant difference in learning outcomes' (Jerzembek and Murphy, 2013: 207).

Substantive studies tend to be more unequivocally positive when it comes to performance skills in learning, rather than merely summative attainment. In a broad review of empirical PBL research, Thomas writes that there is 'some evidence that PBL….has value for enhancing the quality of students' learning', leading to 'increased capability on the part of students for applying those learnings in novel, problem-solving contexts' (Thomas, 2000: 35). At the heart of this quality is the ability, supported and developed by PBL, to actively construct knowledge (Hmelo-Silver, 2004: 239) rather than passively receive it, such that it is 'emergent' in the manner of constructivist and critical realist theories (Blumenfeld et al., 1991: 372).

This active construction of knowledge leads, in the analyses of several writers, to more effective 'use and organisation of relevant information' and 'better conclusions' (Sungur et al., 2006: 158-9). The result is an improvement in learning skills that is 'lasting' and 'robust' (Dochy et al., 2003), a word used also in the assertion of Krajcik et al. that research suggests genuinely open problem-solving leads to the 'more thoughtful and robust learning' needed for lifelong competency (Krajcik et al., 1998: 341).

In Boaler's 1997 analysis of her own research into 'traditional' versus 'progressive' mathematics education, an analysis that relates strongly to situated learning theory, the key difference in the learning of the PBL-influenced students lies in their ability to relate

their acquired knowledge easily to the real world (Boaler, 1997: 93, 95). This ability, according to Boaler, can be tentatively explained through an understanding that the form of learning practised in the 'traditional' group is 'inert' (ibid: 103), whereas the 'progressive' students are able to ally their "live" perception and interpretation to procedural recall, their understanding flowing naturally from an 'apprenticeship' or 'enculturation' in the mathematics of the real world domain (ibid: 104-106).

Collaborative learning

The evidence from empirical studies of the success of collaborative learning as part of PBL tends to focus on the distribution of work and the overall effectiveness of students working together. Thus, Wurdinger et al. deduce that student engagement and motivation in the middle school PBL under scrutiny 'may have been enhanced because students were placed in a situation where they had to work together' (Wurdinger et al., 2007: 158) and Bell reminds us that peer-accountability 'often has greater consequences and provides more motivation for students than if they were only responsible to the teacher' (Bell, 2010: 40).

This cooperation and accountability, according to another group of writers, is particularly vital in complex, ill-structured environments, where the necessity of 'getting inquiry done and carrying it out accurately' is felt (Krajcik et al., 1998: 335). Blumenfeld et al. elaborate this idea more fully, pointing out that substantive research shows successful group work promoting cognitive and social skills, such as 'reasoning and higher order thinking' and 'perspective-taking and accommodation to others' ideas', and the learning of a shared disciplinary language code (Blumenfeld et al., 1996: 38, 39), placing their findings very much in the same area as Boaler's later 1997 and 1999 reflections on situated learning in practice.

However, as Blumenfeld et al. assert, group collaboration can 'diminish thoughtfulness by encouraging reliance on others as resources, thereby decreasing personal responsibility and independent thinking' (Blumenfeld et al., 1991: 377), a tendency I witnessed myself and reflected upon in my short, unpublished empirical study of project-based learning in which it was possible to see both the cooperative energy and the 'freeriding' lack of responsibility happening within groups (Jones, 2014: 16).

If this is fundamentally a social issue in collaborative group work, then an equally problematic situation is voiced by a group of educational psychologists as part of a full-throated attack on constructivist learning. There is, they write, 'overwhelming and unambiguous evidence' in empirical research to show that the free and minimally guided exploration of complex fields by PBL groups 'appears to proceed with no reference to the characteristics of working memory, long-term memory, or the intricate relations between them' and results in cognitive overload of the working memory that is 'detrimental to learning' (Kirschner, Sweller and Clark, 2006: 76). This is a serious charge, and indicates the importance within group work of time for reflection and absorption of emergent, constructed learning into long-term memory, following the distribution of cognitive load through a carefully structured approach to collaboration, utilising the emergent 'distributed expertise' (Hmelo-Silver, 2004: 246) that occurs in the most successful cooperative PBL.

Gaps in the research base for PBL

The above empirical research on PBL, both that from a broadly supportive and that from a critical perspective, is useful and illuminating in terms of this study, but it is noticeable that, whilst the attitudes, ways of learning and successes of students are often foregrounded, there is little attempt to allow the voices of the students themselves to

emerge. Rather, there is a tendency to analyse and evaluate students' experiences of PBL from outside in, with little attempt at reflexivity on the part of the researchers.

Empirical research studies into PBL also tend to favour the investigation of STEM-based programmes, for example in the work of Gallagher et al. (1995), Krajcik et al. (1998), Boaler (1997, 1999), Lee and Butler (2003) and Sungur et al. (2006). There is much less by way of analysis and evaluation of extended student investigations and creative projects in subjects such as art, history and literature, a tendency occasioned perhaps by the natural affinity between subjects such as design, mathematics and science and problem-based and project-based methods.

3.3.2. Autonomous learning

Notwithstanding the challenges identified by Blumenfeld et al. (1991) and Kirschner et al. (2006) cited above, the naturally collaborative student – outward-looking, socially adept, quick to learn from and build on the ideas of others – would also seem to be naturally autonomous through the agency of ideas offered and the stimulation to action of ideas received from others. Indeed, group learning in response to the power of technology has formed part of the work of probably the most influential proponent of autonomous learning in the first two decades of this century, Sugata Mitra.

Mitra is an inspirational figure, his 'Hole-in-the-Wall' experiments attracting much attention, academic and otherwise, to begin with through his online TED talk (Mitra, 2007). The bold notion of introducing computer technology in rudimentary booths into impoverished neighbourhoods in India and elsewhere and monitoring the outcomes of unmediated learning is naturally appealing and has rekindled interest in autonomous approaches, and not solely with regard to the thirst for learning in impoverished rural communities in the developing world. Mitra's 'alternative instructional environments'

(Mitra, 2005: 79) and their 'minimally invasive' adult support structures (Mitra and Dangwal, 2010: 685) offer fresh, emancipatory modes of instruction in a variety of global contexts, including in the UK, and Mitra has himself visited and worked alongside students at the case study school.

Autonomy and the political context

It is useful to set Mitra's work and the outcomes of substantive studies of autonomous learning approaches in their wider political context. Bawden (1988) sets an optimistic tone in his reflection on teaching, learning and leadership at Hawkesbury College in New South Wales, Australia. His work in promoting student autonomy at tertiary level leads him to assert that 'democracy in a society is a function of the autonomy of its people', one which 'it behoves us as educators to develop' (Bawden, 1988: 241). Whilst Holec, in his work with TEFL teachers and students at the University of Stirling, UK, is similarly positive about the importance of autonomy for the learner, he is less sanguine about its benefits, given the 'general environment of dependence and passivity' which then characterised (and continues to characterise) the educational context of both policy and practice (Holec, 1981: 34).

Vieira, in her work with in-service teachers and university researchers through the agency of a working group on pedagogy for autonomy at a teacher training institution in Portugal, sees both opportunities for and threats to autonomous learning in a contemporary environment of policy and practice very familiar to researchers, teachers and students in the UK today. Thus, whilst 'progressive decentralisation of school management' could be seen as 'a measure that supports and facilitates pedagogy for autonomy', Vieira points out that there comes with it 'a resistance to change, reinforced by the government's top-down approach to innovation' and a 'need for greater

accountability', both of which distract institutions from pedagogical transformation (Vieira, 2003: 221).

Different versions of autonomy

Despite the equivocations of Holec (1981) and Vieira (2003), there are several writers, as a result of their empirical investigations and reflections, who point to the need to hold on to a version of autonomy that emphasises agency and eschews a deficit model of the student. Smith, reflecting on five years of work with Japanese university students, distinguishes between a 'weak' version of autonomy, which sees it as a deferred end-product, and a 'strong' version, which is 'based on the assumption that students are, to greater or lesser degrees, already autonomous' (Smith, 2003: 130-131). These two versions are mirrored in the two 'discourses' on autonomy identified by Palfreyman in his evaluation of the learning culture amongst students at a private Turkish university: the 'training discourse', with its 'instrumental orientation', 'instilling appropriate skills through practice' and the 'educational discourse', which allows the learner 'to express autonomy through *choice*' (Palfreyman, 2003: 192, original emphasis).

According to Brophy (1983), this latter discourse, if determinedly pursued, creates the value-rich, endogenous task-orientation which ends by 'stimulating students to value or enjoy the actual process of working on academic tasks' (Brophy, 1983: 211). Brophy's empirical study of student motivation for Michigan State University in the US offers this as a kind of 'cognitive socialization' which, over time, helps students see the intrinsic worth of academic study (ibid: 213).

Educational psychologist Robert Glaser, in his review of a sample of individual reasoning and problem-solving programmes, sees this process as forging 'a new relationship between students and their subject-matter' through which 'knowledge and

skill become objects of interrogation, inquiry and extrapolation' (Glaser, 1984: 103). Higgs (2003) sees such programmes as requiring a 'deliberately ironic' framework, in which structure is consciously designed to *liberate* the student from imposed structure through an emphasis on facilitation, process, resourcing and just-in-time support (Higgs, 2003: 53, my emphasis).

Autonomy, attribution and resilience

According to some empirical researchers, crucial to the endogenous task-orientation that characterises successful autonomous learning is a recognition of the importance of approaches related to the attribution theory of motivation. In such a theory, outcomes of learning are judged by 'their attribution to perceived causes' and not by reference to the innate, unalterable strengths or weaknesses of students themselves (Brophy, 1983: 201). Best known amongst these empirical researchers is Carol Dweck, whose rigorous studies of student motivation over many years as an educational psychologist, with their resultant theories, have been highly influential for both teachers and researchers.

Dweck (2000) identifies two views of intelligence, the 'fixed' or 'entity' view and the 'malleable' or 'incremental' view (Dweck, 2000: 2-3). The first refers to the idea that the ability of a student is immutable, and that her response to failure tends towards 'helplessness', whilst the second sees it as being about a positive attitude to self and change which leads to a 'mastery-oriented' response to failure in which 'students welcome(d) the chance to confront and overcome obstacles' (ibid: 5, 10).

In their painstaking motivational analysis of ninety-one students at five New York schools, Grolnick and Ryan deduced that a fully autonomous environment produces the kind of integration of learning that marks long-term success, and that this occurs through a 'perceived internal locus of causality' (Grolnick and Ryan, 1987: 897), in other words

the incremental, mastery-focused approach later advocated by Dweck. From their analysis of data, Grolnick and Ryan hypothesise that learners with a higher level of autonomy are more likely to integrate learning into long-term memory (Grolnick and Ryan, 1987: 892) and to achieve more sophisticated conceptual understanding (ibid: 892, 897), their research appearing to go a long way to answering the charge levelled at constructivist approaches that they overload short-term memory and limit the opportunity for deeper learning (Kirschner at al., 2006: 76, 80 – see above).

Some evidence of the more widespread effectiveness of this approach can be gleaned from the meta-study of skills intervention programmes by Hattie, Biggs and Purdie (1996). Here, the clearest improvements in how students see themselves as learners are seen as emerging from programmes built around attribution theory in which 'students….change their attributions for success and failure from maladaptive to adaptive ones' (Hattie et al., 1996: 130).

Autonomisation of teachers

Finally, in the view of some writers, there is greater resilience and sustained confidence, too, amongst those teachers who have been observed supporting and developing student autonomy, such that teaching becomes a form of exploratory research which results in a parallel autonomisation of teachers themselves (Smith, 2003: 143). This manifests itself in the creation of learning environments and relationships based on flexible management delegation, trust and support, and an espousal of 'situational leadership', the idea that the teacher adjusts her strategies and methods to match the readiness to take responsibility of the learner or learners she leads (Higgs, 2003: 55-56).

3.3.3. Authentic Learning

The thrust of all the theoretical and empirical research considered thus far seems to point in the direction of learning and teaching that moves away from passivity, efficient curriculum delivery, centralist and credentialist control and the notion of delivery. Instead, there is the idea of learners and teachers who attain resilience and autonomy through approaches based, broadly, on constructivist principles and on the creation of knowledge through situations which approximate as far as possible to so-called real world learning in a kind of extended, apprenticed immersion in challenging contexts. In other words, they point to what a group of empirical researchers refer to as *authentic* approaches to knowledge, understanding and personal growth.

The research base for authentic learning is relatively small and based almost entirely on the US context, but is a useful addition to this review. That of Nicaise, Gibney and Crane (2000), in their analysis of student perceptions of a real-world learning experience in science in a US high school, echoes very precisely the purposes of this study in moving 'from an assumed and theoretical view of what authentic learning means and looks like to a more empirically driven, first-hand account of students' perceptions' (Nicaise et al., 2000: 83).

The key elements of authentic learning

Newmann, Marks and Gamoran (1996), in their evaluation of the School Restructuring Study (SRS) carried out in 130 mathematics and social studies classrooms in 23 'restructuring public schools' in the US in the 1990s, give us a summative description of authentic learning at its best, defining it as 'construction of knowledge through disciplined inquiry to produce discourse, products, or performance that have value beyond success in school' (Newmann et al., 1996: 287). The three elements of authentic learning they isolate in this text (knowledge construction, disciplined inquiry, beyond-

school value) come from a consideration of the real world mastery of 'successful scientists, musicians, entrepreneurs, politicians, craftspeople, attorneys, novelists, nurses, and designers', linking the kinds of apprenticeship model occurring in these occupations to the 'cognitive apprenticeship' of the teacher/mentor (ibid: 282, 285).

They go on to delineate the detailed 'Standards for Authentic Pedagogy and Student Academic Performance' used by the SRS in assessing the success of learning projects occurring in the 23 schools in the study, based on 'Classroom Instruction', 'Assessment Tasks' and 'Authentic Academic Performance' and incorporating such key criteria as 'higher-order thinking', 'deep knowledge', 'disciplinary content/process' and communication with an 'audience beyond the school' (ibid: 288-290). Their overall evaluation of the learning in the focus schools is based on three findings, the first, whilst noting the progress made by individual teachers, suggesting that 'levels of authentic pedagogy observed….fell well below the highest levels of the proposed standards'. Despite this finding, the second suggests that there was, nevertheless, evidence of improved authentic academic performance and confirmation of 'the robust relationship between authentic pedagogy and student performance', and the third that this effect is equitable across gender, race, ethnicity and socio-economic groups (ibid: 305-306).

Like Newmann et al., Lombardi (2007), in his meta-study of research into authentic learning, stresses the 'concrete connections' ('interpersonal', 'intellectual' and 'personal') between the individual learner and the disciplinary knowledge and skills of experienced practitioners (Lombardi, 2007: 2). Again, like Newmann et al., he offers a list of characteristics of authentic learning, this time focusing on design elements rather than assessment standards. Amongst these are 'real-world relevance', 'ill-defined problem(s)', 'multiple sources and perspectives', 'collaboration', 'polished products' and 'multiple interpretations and outcomes' (ibid: 3-4). The most interesting and

suggestive of these is the idea of the 'ill-defined problem', with its emphasis on allowing students as much free rein as possible and on eschewing tightly defined programmes of work with predictable outcomes.

In the empirical study of Nicaise et al. (2000), a number of the points raised by these writers find echoes. Their central point is that conventional modes of learning 'try to short-circuit the natural learning process' through 'classroom instruction' that 'cuts to the chase and rushes to present answers to questions students have not yet asked', with a resultant absence of 'student ownership' (Nicaise et al., 2000: 90). Too much attention, they argue, is devoted to 'what is already known' and not enough to 'finding out the unknown' (ibid: 79), partly echoing the 'ill-defined problem' of Lombardi. They find that student learning works best when it is 'regulated internally by students and not externally by false reinforcers, such as grades or points' (ibid: 80) and follows an apprenticeship model of gradually faded instruction and scaffolding which develops into liberating and sympathetic mentoring (ibid: 82).

All this suggests putting students in situations of considerable challenge, a challenge articulated even more forcefully by Osberg and Biesta (2008) in their championing of the primacy of the critical realist idea of 'emergent' meaning in environments deliberately designed to 'unsettle the doings and understandings of those being educated' so as to 'keep the way open', even if such an environment is 'difficult and provocative and often uncomfortable' (Osberg and Biesta, 2008: 326).

Authenticity and real-world learning

Common to all these descriptions and rationalisations of authentic learning at its best is, as already mentioned, the idea of incorporating or linking strongly with the disciplinary knowledge, understanding and skills of the real world beyond school.

Thus, Lombardi (2007) argues for a ‘more complex set of competences’ than can be acquired through the ‘foundational skills’ that most schools offer, competences which involve ‘being able to get things done, demonstrate ethics and integrity, and work well with others’ and which can be achieved ‘by confronting students with uncertainty, ambiguity and conflicting perspectives’ in order to ‘develop more mature models that coincide with the problem-solving approaches used by experts’ (Lombardi, 2007: 10), a methodology very much in tune with a more recent movement, *Expansive Education*, which provides a portfolio for a range of similar approaches (see Lucas, Claxton and Spencer, 2013).

Interestingly, Hart’s 2007 survey of US employers echoes Lombardi’s argument. The majority of employers, Hart finds, strongly support ‘integrative learning’, which is defined as ‘the ability to apply knowledge and skills to real-world settings’, value ‘intellectual and practical skills’, such as ‘the ability to locate, organize, and evaluate information from multiple sources’ and solve ‘complex problems’, and voice the need for the ‘personal and social responsibility’ acquired through ‘teamwork skills and the ability to collaborate’ which, amongst other aspects, lead to a ‘sense of integrity and ethics’ (Hart, 2007: 2).

Authentic learning: some words of caution

Despite the positive challenge of authentic approaches articulated by different writers, and the sense of a concordance between the findings of empirical research and the challenges of the real world, there is a note of caution in the analysis of data from the empirical study of Nicaise et al. into an authentic space science programme. Their research reveals that authentic work sometimes falls away to mere time-filling activity, describing some students on the programme as feeling that ‘classroom projects and

activities were not closely associated with the field under study' and that they were 'doing….activities that real aerospace scientists or engineers would not pursue' (Nicaise et al., 2000: 91). There is agreement here with the point made by Anderson, Reder and Simon (1996) that the success of authentic learning is not dependent upon 'what real-world trappings it might have' or what 'busy work' is undertaken as a substitute for genuine knowledge-creation or a shift in understanding (Anderson et al., 1996: 8-9).

However, this view is balanced by much more positive feedback from students on the space science programme reviewed by Nicaise et al. about the excitement of real-world work and its distinction from more conventional classroom learning. This student's direct testimony echoes that of several in the study:

> 'For a while, you're in the real world actually working. You have to get out of the role of playing a student like in other classes. Like on tests, in other classes you memorize stuff and spit it out on the test, and that's all you remember' (Nicaise et al. 2000: 89).

This somewhat equivocal evidence of the effectiveness of authentic approaches leads the writers to pose a set of eight 'unanswered' questions, chief amongst which are 'What makes a task an authentic task for some and not for others?', 'How are student-selected culminating activities different from teacher-created ones?', 'Why are some students successful in authentic classrooms where others are not?' and 'How do successful students manage their own learning in authentic classrooms?' (ibid: 93). These questions, about difference, learning management and student autonomy are very close to the core issues which my own study has attempted to explore.

3.4. Research trends and implications for this study

The first thing that is clear from this review is how little developed, peer-reviewed research into the areas of PBL, autonomous learning and authentic learning has taken place in the last decade, particularly in the UK. This is, perhaps, not surprising, given the context of credentialist policies in education and the drive for accountability through formal testing and inspection during this period. These ongoing policies and their effects have been charted by several writers. Ranson et al. (1996), for example, chart the failure of educational policies in the 1990s to emancipate underprivileged students (Ranson et al., 1996: 25) and Boaler traces the growth of 'inert' knowledge as a consequence of an over-emphasis on testing (Boaler, 1997: 103), whilst Osberg and Biesta (2008) evidence the limitation of varieties of meaning in schools through enculturation into an acceptance of competency outcomes (Osberg and Biesta, 2008: 4). This lacuna prompts the observation that the most pressing need of all is for there to be *some* empirical research into constructivist approaches to learning in more recent times, since these approaches hold at least the possibility of developing broader, more emancipatory, more autonomous learning.

From the research that does exist, it is apparent that there are three main trends in terms of research subject. The first of these is the preponderance of studies on undergraduate or professional learning contexts, as Hmelo-Silver points out (2004: 252, 256). The second trend concerns the choice of academic subject as the focus for problem- and project-based learning, this being heavily biased towards Science, Technology, Engineering and Mathematics (STEM) subjects, as I have already discussed above and as Thomas confirms: 'Research on PBL implementation is largely limited to research on project-based science administered by teachers with limited prior experience with PBL' (Thomas, 2000: 34). The third is the tendency of studies to concentrate on the work of teachers, not students. This is not surprising, given the involvement of university

teacher-training departments in a significant number of studies (see, for example, Holec, 1981; Brophy, 1983; Vieira, 2003).

The gaps in the knowledge base, then, are reasonably clear. New empirical research needs to focus on, first, the student's point-of-view. The impact of such work ought to be on improving understanding of the relationships between students and other students and students and adult mentors (see Azer, 2009: 1040), how account is taken of 'student preferences' in different approaches to constructivist practice (see Jerzembek and Murphy, 2013: 215) and 'students' perceptions of, and orientations toward, classroom experiences' in the broadest sense (Ertmer, Newby and Macdougall, 1996: 749). Further, whilst there is some discussion of students' intrinsic motivation during constructivist programmes, there is 'little research that bears directly on this issue' (Hmelo-Silver, 2004: 259).

Second, we know relatively little about the effectiveness of challenging constructivist approaches in non-STEM subjects, of, for example, 'what constitutes meaningful evidence of PBL effectiveness in disciplines….within which students' demonstration of proficiency is less straightforward than it is in laboratory science and mathematics' (Thomas, 2000: 36). In STEM subjects, however difficult the level of analysis, the grounds of logic and the hypothetico-deductive method are usually in place, and the evidence largely quantitative in nature. This is less so in the more openly creative, performative and evaluative subjects such as music, literature and history, where the constructivist approach and its more qualitative outcomes need to be considered differently. Constructivist programmes of research-based learning were, at the time of my study, to be found in STEM and non-STEM subjects at the case study school.

Outside of Boaler's work (1997, 1999), this review has found very little research into UK secondary or tertiary students' learning in constructivist environments and much of the available literature specifically on authentic learning comes from research into US university or professional environments, the work of Nicaise et al. (2000) on high school authentic science being a notable exception. Thus, the third imperative is for empirical research to consider students' real-world learning in a UK school context.

3.5. Summary

I began this review by identifying the theoretical and empirical contexts of the case study school's programme of research-based learning and went on to consider constructivist approaches, particularly those of Vygotskyan proximal development and emergent learning, which I linked to the reproduction-transformation dialectic of critical realism. I continued by examining the constructivist tenets of situated learning theory, with its emphasis on the legitimate peripheral participation of learners in communities of practice, and those of transformational learning theory, with its emphasis on learner agency.

The establishment of this theoretical context is supported and extended by a review of evidence from substantive studies of PBL and autonomous learning and a review of mainly US empirical studies of authentic learning programmes which embody key elements of real-world learning practice.

An overview of the literature has suggested that much of the existing research into the effects of problem- and project-based learning and authentic learning is from the US, and a significant proportion of it based on STEM programmes, higher education or professional learning schemes and teacher-led procedures. Thus, I identified the need

for this case study to focus on UK students' conceptualisations of their involvement in current real-world research activities in a range of STEM and non-STEM subjects.

Chapter Four: Methodology and methods

4.1. Introduction

This chapter begins with an examination of case study. I describe how its relevance for my research flows from my capture of critical realism as an ontological base for the research, and consider how a single case can illuminate both the nature of emergent institutional culture and student agency and sense-making, through a study which is itself emergent. I review the different forms of case study, focusing in particular on two key types – the intrinsic and the instrumental – explored by Robert Stake (Stake, 1994, 1995, 1998). I go on to examine the evaluative possibilities of case study and to consider the difficult issues of generalisation and the role of pre-existing theory.

I begin the section on strategies for data collection and analysis by describing how and why I made an important shift in the sequencing of data capture methods and go on to make clear how participants in the research were selected and to reflect on my role in the interviewing process. I end by explaining my data analysis methods and the ways in which Nvivo 11 software has been used to codify the rich and varied data from different sources and to facilitate the emergence of superordinate themes for the data discussion phase of the study (Chapter Five).

4.2. Case study

Since this study had its genesis in a direct invitation to carry out research from the head teacher of a particular institution, the choice of case study as methodology was clear and unambiguous. The challenge was to carry out research at the school into what was beginning to be called *research-based learning*, a pedagogical approach of which I myself had had some professional experience, and it offered an ideal opportunity to immerse myself in the type of learning it encourages and to see this learning from the

student's point-of-view, whilst at the same time examining critically the assumptions behind the emergent pedagogy itself.

In beginning the study, I carried with me a concern for the nature of emergent institutional culture and student agency which I derived from the critical realist paradigm, a paradigm intimately related to theories of situated learning and communities of practice. This theoretical background had to blend with, or form a critical alternative to, theories already espoused by the case study school in their development of a distinctive pedagogy.

Since I was not concerned with causation (in terms of impact on examination results, for example) this has been a predominantly qualitative study, with quantitative data being limited to the results of a broad survey of student attitudes to learning in the school carried out by the school itself before the observation and interview phase. However, the study crosses the distinction made by Walker (1985: 22) between 'impact' and 'process' analysis since it has considered both means and ends, though in terms of students' understanding and conceptualisation of their roles and relationships rather than their examination performance.

4.2.1. Defining 'case study'

A straightforward definition of case study occurs in Newby (2010). This is a definition almost deliberately designed to cover all positions, but it is still one that works:

> A case study is a detailed analysis of an individual circumstance or event that is chosen either because it is typical or because it is unusual or because there was a problem or because something worked well (Newby, 2010: 51).

Whilst he is very open here, Newby later identifies the case study as a 'type exemplar'. This way of seeing the case study chimes with Gomm, Hammersley and Foster and their assertion that, semantically, we ought to see such a study as 'a *case of* something' (original emphases) (Gomm et al., 2000: 102). This is what we might call the *tight* definition – that we necessarily have a category of phenomenon in mind when we approach our case, since this is implied in the phrase *case study* itself. It minimises disputation about generalisation, since we start with the general in mind in the first place.

However, another, looser, approach can be found in the work of, for example, Stake and Bassey. The latter, drawing on Simons (1980), employs the memorable phrase 'the Science of the Singular' to describe the case study (Bassey, 1999: 22). This lays out neatly the idea that we can be interested in the case more for its own esoteric qualities than for its general significance or theoretical exemplification. Thus, Stake writes of the 'epistemology of the particular', the idea that in case studies we are often more concerned with the knowledge and understanding we can glean from one or two cases than we are with their broader significance (Stake, 1994: 240). Elsewhere, Stake makes this view more explicit, going as far as to write that our principal duty as case researchers should be 'not to represent the world, but to represent the case' (Stake, 1998: 104).

Relevant elements of this looser approach foregrounded in my research were the observation and analysis of how students work in context and the sustaining of their individual views in the final case report. This chimes with Geertz's well-known assertion that what qualitative study gives us that quantitative study cannot (at least, on its own) is 'thick description', the detailed, complex, sometimes contradictory evidence of people in context which nevertheless leads the researcher to draw 'structures of signification' from it (Geertz, 1973: 6, 9). Stenhouse sees the key focus of case study as the 'interplay of action with context' (Stenhouse, 1978: 30), an interplay I was very much interested

in capturing in my own study, especially since both these elements are crucial to the critical realist paradigm. I also aimed to capture and retain the voices of students themselves in the final report, the 'multiple realities' (Stake, 1995: 12) informing 'multi-perspectival' analysis (Tellis, 1997: 4), and thus retain a measure of verisimilitude in terms of the authenticity of students' reflective narratives.

4.2.2. A typology of case study

One of the most useful distinctions in the literature on case study is made by Robert Stake. In several papers and contributions to texts, Stake distinguishes between the 'intrinsic' and the 'instrumental' case study (Stake, 1994, 1995, 1998). He defines the latter as a study 'examined to provide insight into an issue or refinement of theory', the case itself being, 'of secondary interest', whilst the former is 'undertaken because one wants better understanding of this particular case' (Stake, 1998: 88). Stake's categories link, to some extent, with Yin's distinction between 'internal' and 'external' validity, where internal validity derives from defensible explanations within the context of the case itself and external validity from theories we may, or may not, be able to draw beyond the individual case (Yin, 2014: 47-48).

Yin also identifies several analytical techniques through which we can perceive differences in case study types. These differences can be reduced to those which are iterative and those which are non-iterative. Yin sees, in particular, pattern-matching, explanatory studies as requiring an iterative process of proposition and data matching, followed by revision after revision, until a satisfactory explanation for the phenomenon has been achieved. For Lincoln and Guba, however, it is a matter of levels in a taxonomy of case analysis. Thus, we begin with the 'merely factual' level, moving, if the study and the case require it, to an 'interpretative' level and on to an 'evaluative' level (Lincoln

and Guba, 1985: 361). This latter process is ultimately what interested me in pursuing my own study.

4.2.3. Evaluative case study

It is Bassey who discusses most helpfully what evaluative studies are and how they operate. In particular, he demonstrates how there are flexibilities of approach which enable an evaluative study to 'fit' the case effectively. He defines evaluative case studies within education as 'enquiries which set out to explore some educational programme, system, project or event in order to focus on its worthwhileness' (Bassey, 1999: 63). It is immediately clear from this that the evaluative study is more narrowly focused than, say, a purely exploratory study and that it goes beyond mere descriptive factuality. In its notion of 'worthwhileness', it also has a practical purpose which may be absent in a purely explanatory study.

This might be to suggest that the evaluative study is locked into, and confined by, an assessment of 'the extent to which the programme's stated objectives have been achieved' and indeed this is one 'tightly structured' form which, Bassey acknowledges, the evaluative case study can take (ibid: 63). However, he also opens up the possibility that such a study can be 'illuminative': that is, designed to shed light and reveal hitherto unrecognised qualities and outcomes. In this sense, whilst an evaluative study may begin with narrow and exogenously defined aims and objectives, it has the potential to move beyond these, contributing a priori ideas of its own and culminating either in a summative assessment of the phenomenon or programme studied (in a particular time-frame and context) or in a formative set of recommendations intended to be of practical use in the development of particular ways of working (ibid: 63).

There are two issues with evaluative studies, however, which must be confronted, and they are clearly related. One is that of theory – the way in which an evaluative study might draw on theory and the way it might contribute to its adaptation or development – and generalisation – the question of whether a tightly focused evaluative study can be seen to generalise from its findings, and, assuming generalisation to be possible, how this might emerge.

4.2.4. Generalisation from case study

On this subject, the literature presents us with a variety of responses. For both Clark (2005) and Gomm et al. (2000), no findings from educational research can be generalisable or replicable, by virtue of the inherent heterogeneity of human beings and situations and the fact that all educational phenomena are, of their very nature, unique and context-bound. Stake takes a less extreme stance: generalisation is possible, but should not be pursued with too much vigour, such that 'the researcher's attention is drawn away from features important for understanding the case itself' (Stake, 1998: 91).

Yet Evers and Wu (2007) posit very persuasively three factors which suggest that, whilst 'complex and difficult', generalising from a single case is a more natural, trustworthy process than is sometimes thought. The first of these is the fact that 'cases possess considerably more structure than is commonly supposed' (Evers and Wu, 2007: 212). Here, they refer, for example, to the constitutive and regulatory rules and language which govern all social behaviours and which are shared by researchers and participants alike. Second, they remind us that researchers carry into the research context a large amount of knowledge and understanding which helps them to interpret what they see. Third, by looking towards abductive (rather than deductive or purely inductive) inference, they

can contribute to a rich, cumulative acquisition of understanding over time (ibid: 199-201, 212).

For Stake, this abductive approach can be expressed as 'naturalistic generalization', a form of generalising which he sees as very personal, and to do with human experience. It depends upon a 'tacit knowledge of how things are, why they are, how people feel about them, and how these things are likely to be later or in other places with which this person is familiar' (Stake, 2000: 22). This is, of course, very different from the inductive reasoning of science, but Stake argues that, in trying to understand messy social interactions, such as those that occur in schools, 'abstract statements of law distract attention from direct experience' (ibid: 23). It follows from this that the kind of generalising that takes place naturalistically tends to attach itself to one or two similar cases, rather than a case population, and the way it happens can often be ad hoc and emergent, such that the understanding it can bring us to can be unexpected (see Stake, 1994: 238).

This leads quite naturally to Bassey's 'fuzzy generalisation', by which an emergent understanding of case phenomena can lead to a generalisation that is 'neither likely to be true in every case, nor likely to be untrue in every case: it is something that *may* be true' (Bassey, 2001: 10, original emphasis). This kind of generalisation is, for Bassey, a 'proper outcome of research' (ibid: 19). In particular, it is something that serves educational research well, since it openly invites other practitioners to reflect on, amend and implement an idea, 'to "try it and see if the same happens for you"' (Bassey, 1999: 52). Thus, theories emanating from case study research can be 'suggestive' rather than appearing as statements of truth (Feagin et al., 1991: 16).

The outcomes of such suggestive, fuzzy theories can often form a 'working hypothesis' (Yin, 2014: 40-41) which depends for its effectiveness on the 'transferability' of its central idea (Lincoln and Guba, 1985: 123). The importance of such a working hypothesis from the practitioner's point of view is its 'relatability', the degree to which a teacher can relate the area of practice it illuminates to her own practice (Bassey, 1981: 73, 85). In other words, to borrow a term from educational leadership, the whole effect should be that of *distributed research*.

Where I have felt the evidence from the study to be substantial and significant, I have made confident assertions in my analyses, syntheses and conclusions, but generally I have taken the approach of Feagin and Bassey in positing suggestive and "fuzzy" generalisations, especially where they have implications beyond the case study school itself, and deliberately engaged with other professional educators through this transferable, "distributed" approach.

4.2.5. The role of theory

It is hard to escape the fact that doctoral study must be, at least to some extent, theoretical. Even if, as researchers intent on the most grounded of inquiries, we wanted to rid ourselves of all pre-existing theories, it would, as several writers point out, be impossible. Thus, there is 'no such thing as presuppositional research', even if, in the end, we need not be 'tied to our own frameworks' (Jones, 1985: 47), and we do not arrive at a research study 'intellectually empty-handed' (Geertz, 1973: 27). Practically speaking, we may also be 'forced to state some propositions', enabling us to 'move in the right direction' at the start (Yin, 2014: 28).

But it is what happens next that is crucial. If continued use of theory as the research progresses results in mere appeals to authority, to nothing more than 'legitimatory

label(s)' (Hammersley, 2012: 399), then the researcher is surely not attending fully to what the data is telling her. Even where reference to theory from the literature is more meaningful, there can still be a 'false consensus' between data and pre-existing notions if theory is employed too rigidly (Simons, 2009: 33).

So how, then, should theory operate in a case study such as this? I take the view that, first, all theories from the literature need to be rigorously examined for the extent to which they are, as Bassey puts it, 'strictly pertinent to the enquiry' (Bassey, 1999: 61) and that they should form a '"conceptual background"', informing, but not driving, the data collection and analysis. Another writer puts this idea cogently: we build 'understanding about the social world which is firmly grounded in the concepts and theories of the persons inhabiting and acting in it', a premise, of course, wholly in keeping with the approach of the critical realist, but there will always be 'superordinate…."sensitising concepts"' with which the researcher compares, contrasts and brings together evidence for her particular audience (Jones, 1985: 59), or, as Geertz has it, 'the office of theory is to provide a vocabulary in which what symbolic action has to say about itself….can be expressed' (Geertz, 1973: 27).

This approach to theory and case study is very much in keeping with the conceptual framework I have employed in this research. From a critical realist point of view, the approach foregrounds emergent ideas which are transformative whilst acknowledging the reproduction in this emergence of some existing concepts and vocabularies. Thus, what pertains, for critical realists, in social structures more broadly was also a part, more locally, of the emergence of students' knowledge and understanding through research and the emerging method of my own study. This can be seen most obviously in Chapter Six in the ways in which fresh theory emerged from a synthesis of my discussion of data from the case.

4.3. Validation of the study

My approach to validation has been very close to that of Creswell in terms of its use to 'emphasize a process' rather than attempt any kind of quasi-quantitative verification (Creswell, 2013: 250), an idea clearly linked to emergent knowledge, but also having within it the principle of validating the participant voice. The attempt in my study was to allow naturalistic theories to emerge from understanding built on 'plausible interpretations' of 'critical elements' (Wolcott, 1994: 366).

Creswell identifies eight validation strategies (Creswell, 2013: 250-253), recommending the use of at least two in any qualitative study. I have employed four of these in this research.

In terms of *triangulation*, I have adhered to Creswell's axiom that 'when qualitative researchers locate evidence to document a code or theme in different sources of data, they are triangulating information and providing validity to their findings' (ibid: 251). Interview, observation and documentary data have offered just such validity in this study, together providing the 'confluence of evidence that breeds credibility' (Eisner, 2017: 110).

I have also clarified *the precise nature of my researcher bias*: the ethics section of the introduction to this study makes clear the unusual circumstances in which the research operates and the nature of my precise role. In terms of *member checking*, there were informal discussions with students during and after observations and all transcriptions were sent to participants to be checked for accuracy and to allow them to change their response, should they wish to do so.

Finally, I have used *rich, thick description* in the study, especially in the detailed extracts from participants' interview responses. These have allowed the nuances of their views

to come across directly and enabled readers to ‘transfer information to other settings and to determine whether the findings can be transferred’ (Creswell, 2013: 252) through a principle of *distributed research* (see above).

As I made clear in the introductory chapter, the intention of this study was not to employ evaluative case study to set students’ participation in research-based learning against their examination results. This would not have been in keeping with the purpose and objectives of this qualitative study, and such a quantitative approach would have been at odds with a metric of success appropriate for research-based learning. Such an approach would, in any case, have been impractical, the influence of student research work on their results being impossible to gauge, given the many other possible variables, including the wide differences in the type, length and intensity of the research programmes themselves, the different choices of A Level course made by research students and the fact that even those studying exactly the same subjects for A Level had often had different teachers. Other, more personal, variables might include the different experiences students had had in earlier schooling, the variation in the supportiveness of the home environment and the fact that some students had undergone significant change in their personal lives (for better or worse).

4.4. Strategies for data collection and analysis

4.4.1. The initial strategy and why it changed

In my planning, I had intended to carry out interviews with Year 12 and Year 13 students, teachers and leaders, and to follow these by observations of student research groups at work and the reading of relevant documentation in order to set what the students had said against first-hand experience and relevant school policy and recommended practice. However, it quickly became apparent that the interviews, whilst

signalling my focus on the student voice, would be taking place in a context about which I was less informed than I would wish to be, and that I would be led too much by my reading of the literature when formulating questions and drawing initial theories.

I therefore decided to read the small amount of documentation that was available from the case study school and carry out my observations before, or partially in parallel with, the interview process. This gave me the opportunity to ask questions and pursue students' spontaneous thoughts based on issues I had seen played out, for example, in actual research group sessions, whilst my reading of the literature remained influential in shaping and enabling me to challenge my preliminary analyses. This is a version of the *constant comparative method* of qualitative data gathering and analysis (see Glaser and Strauss, 1967), but allowing for some validation of, or challenge to, existing theory. It was a method which allowed me to work with focused dispatch but to attend to the evidence of student research work in actuality and their own conceptualisations of what was occurring.

4.4.2. Selection of participants and data collection through semi-structured interviews

My original plan for the selection of interviewees was to write my own questionnaire for all Year 12 and 13 students, asking them to provide details about their participation or intended participation in research projects. From the returns, I hoped to choose a range of students to provide a representative sample across both years of the sixth form. However, it emerged that the school had already issued a questionnaire to students of a very similar kind, the results of which were at that moment being analysed internally. Satisfying myself that the information from this questionnaire was likely to be as useful as that from my own questionnaire, and fearful that issuing another, very similar,

questionnaire would be likely to generate a limited number of returns, I decided to use the data from the school's own survey.

I decided that my first choices of participants from this information should pay careful attention to:

- The need to balance male students with female in proportion to the actual numbers in the sixth form
- The need to balance internal students (all male) with those who had arrived from outside into the sixth form (female and male)
- The need to consider a range of projects from science, design, the humanities and the creative and performing arts
- The need to include, amongst others, those students whose work in their project/s seemed intriguing, unusual or likely to offer useful insights.

As I looked through the data from the survey, it was clear that it would be difficult to put together a list of students which met all of these criteria. In particular, the returns indicated a proportionally large number of external students committing to challenging projects and proportionally fewer internal students doing so. After further dialogue with the head of research, however, it seemed perfectly reasonable to include a disproportionate number of externals since this reflected the actual commitment to research work, many of these students having come to the school specifically to undertake projects.

My sampling methods in the interviews, both individual and group, were what Creswell refers to as 'purposeful' (Creswell, 2013: 154), since I made a choice of specific participants in order to explore the responses of particular groups of students, school leaders and teachers to arrive at a broad and inclusive understanding. Thus, I followed

the strategy recommended by Creswell (2013), in first establishing an overall differentiating criterion for the selection of participants (sustained involvement in individual or group research activities) and then using maximum variation sampling to 'reflect differences or different perspectives – an ideal in qualitative research' (Creswell, 2013: 157). The choice of student participants for the group interview was to some extent by 'convenience sampling' (Creswell, 2013: 158), since I was reliant on the goodwill of students who had already been individually interviewed by me.

The final selection of students chosen for sampling were invited to participate by email, and almost all agreed to do so. Interviews were held at the school, and consisted of a series of loosely structured questions put by me to individual students. One final interview was with a group of four students, affording them the opportunity to respond more freely and interactively. All interview data were recorded using an audio recorder and transcribed by me, without the use of either paraphrasing or transcription software. In the transcriptions, I was able to include hesitations, repetitions, expostulations and false starts where these were significant in the way participants' conceptualisations were expressed. This method also contributed to the reliability of the research, which 'can be enhanced if the researcher obtains detailed field notes by employing a good-quality….recording, and by transcribing (it)….to indicate the trivial, but often crucial, pauses and overlaps' (Creswell, 2013: 253).

Before and during the period of student interviewing, I also interviewed a smaller number of teachers and leaders at the school to explore the perspectives of those setting policy and guiding students through research work. The first, long interview with the head teacher formed an important basis for my understanding of the school's strategy for pedagogical development, and the other interviewees were chosen to reflect the range of subject areas and responsibilities involved in research-based learning.

My decision to use semi-structured interviews was in order to offer participants (particularly students) the opportunity to answer questions largely on their own terms, whilst providing a 'structure for comparability' (May, 1997: 111). This also coheres with the idea of an interview as a 'conversation with a purpose' (Burgess, 1984: 102), or 'steered conversation' (Hedges, 1985: 78), rather than something more, or less, formal. The strength of the group interview with students that followed the individual interviews lay in promoting the 'why?' question (Stroh, 2000: 198), respondents explicating and justifying attitudes under challenge from peers (Pole and Morrison, 2003: 40), whilst I acted as 'moderator' to 'establish and facilitate' debate (Watts and Ebbutt, 1987: 27).

4.4.3. The conditions under which interview data was obtained

One of the key criteria for assessing the effectiveness of a case study, according to Creswell, is whether the researcher has been 'reflexive or self-disclosing about his or her position in the study' (Creswell, 2013: 265). With this in mind, in this section I reflect openly on my role in the interview process and how it might have been seen by students. This section should be seen, also, in the context of the introductory and concluding reflections of the study (1.1. and 7.5.) where I have been reflexive in a rather more personal way and of the section covering the limitations of the research (7.4.).

My expectation was that, as an interviewer, I would come across to students as neither a member of staff nor an academic outsider, but as something in-between. Before each interview, therefore, I confirmed for each student that I had been an assistant head teacher at the school, but also adopted a very relaxed and unthreatening persona, dressing informally and making sure the student was comfortable with the interview room, the audio recording process and what would happen to the data in terms of transcription and citation. My impression was that almost all students, after a minute or

so of initial awkwardness, treated me entirely as an academic researcher from a local university. This seemed to allow them to reply openly and frankly to my questions without feeling that I would "report back" to their teachers.

My persona and role were substantially the same in the first ten minutes or so of the group interview, students still tending to address their comments to me – there was a sense with the three students who had participated in individual interviews that they had "been here before" and already had a known and comfortable relationship with me. After ten minutes, however, all four began to respond directly to one another's comments, and I was able to take a less prominent role, speaking only occasionally to move the discussion forward.

My role and persona were naturally a little different in the interviews with leaders and teachers. There was much less of a need to put the participants at their ease, especially those whom I had known professionally whilst at the school. I was aware, with these ex-colleagues (including the head teacher), that there was a danger of researcher 'myopia' (Mercer, 2007: 6) and, on their part, of too much uncritical ease. For this reason, I moved to precise and probing questions much earlier than was the case in the student interviews.

I was unaware of any effects produced by my age or gender on the student interviewees. My inevitable projection of a professional, middle class persona was met largely with ease by most of the students, there being few who were not themselves from professional families and well used to reflective conversation. This facilitated an openness which was helpful in exploring the issues involved, but it also exposed the limitations of this research in terms of addressing the experience of less privileged students (see Chapter 7).

4.4.4. Data analysis

In order to interrogate the rich and profuse data from the study, I followed the 'hybrid' approach recommended by Boyatzis for 'single unit' studies (Boyatzis, 1998: 52), mindful of the danger of being confined by too many initial, theory-led codes which might 'blinker analysis', but aware also of the 'lack of clear direction' and sense of being 'overwhelmed' when guided only by the raw data (King, 2004: 259). The study aimed to produce, at the end of the process, a report which 'interweaves literature with the findings' to produce a 'story' of the data that 'stands with merit' (Nowell, Norris, White and Moules, 2017: 11).

The process I employed in the study is that of *thematic analysis*, described by Boyatzis as enabling 'scholars, observers, or practitioners to use a wide variety of types of information in a systematic manner that increases their accuracy or sensitivity in understanding and interpreting observations about people, events, situations and organizations' (Boyatzis, 1998: 5). The process was initially 'a way of *seeing*' that progressed to the '*seeing as*' of encoding through defining and naming (Boyatzis, 1998: 1, 4, original emphases), so that I, as the researcher, moved 'from unstructured data to the development of ideas about what is going on in the data' (Nowell et al., 2017: 6). In choosing to work with themes derived from the coding of raw data, albeit guided by my understanding of the relevant literature, I was attracted by the 'theoretical freedom' of this approach which nonetheless produces 'a rich and detailed, yet complex account' (Nowell et al., 2017: 2).

I have followed the scheme outlined by Nowell et al. in developing the thematic analysis, beginning with familiarisation (Phase 1), generating initial codes (Phase 2), drawing out themes, reflecting on them and defining and naming them (Phases 3-5) and moving through synthesis and interpretation to a final report (Phase 6) (see Nowell et al., 2017: 4). During this development, following the recommendations of Nowell et al., I have

kept careful reflexive notes of both my observations and my initial thoughts about their significance, as well as scrupulous notes of formal and informal discussions with supervisors and carefully stored and transcribed data from interviews with students and teaching staff (see Nowell et al., 2017: 3, 5). It should be noted that I have referred to the final themes isolated from the coding scheme as *superordinate*; this was to distinguish them from earlier thematic thinking that led to the initial coding process itself.

As part of this process, the coding of data, based on first impressions, on the likely relevance of some theoretical perspectives and on later iterative reflection on the usefulness of the initial codes, was carried out using software. This enabled me, as it has enabled other researchers, 'to work efficiently with complex coding schemes and large amounts of text, facilitating depth and sophistication of analysis' (Nowell et al., 2017: 7).

4.4.5. The use of Nvivo 11 software and the choice of superordinate themes

Coding using Nvivo 11 was a developing process. From my being present at research sessions and from interviews, there were immediately obvious codes that suggested themselves (for example, student autonomy) and almost all of these continued to be important as I transcribed and interrogated the data more rigorously. However, there were other aspects which had not been so obvious initially, and these were added to the node structure in Nvivo (for example, soft skills). Some aspects which had seemed important at the first or second stages of analysis emerged as less important later on, as the number of occurrences and correspondences with other data proved too few to be useful (for example, gender differences), whilst some larger parent nodes gave rise to sibling nodes as greater refinement of the data occurred. At the same time as data from

the interviews was coded in this way, I was also able to code sections of my observation notes and extracts from documentation using the same nodal structure, thus developing points of triangulation from different data sources. At no stage was automatic analysis or text frequency searching of data used – Nvivo 11 was used solely to organise a large body of rich data and all judgments about the type and significance of data were made by me as researcher.

At the end of the process of codification, some 42 parent or sibling nodes had been formed from the data (see Appendix 6). Whilst this provided a very full and detailed description of my analysis, it was obvious that it would be cumbersome and over-complex as the basis for discussing the data and developing conclusions from them. I therefore decided to work with larger, superordinate themes as the analysis moved forward. This happened, in fact, quite organically as an emergent process, my understanding of the importance of key overarching themes being strengthened partly through the number of codings in parent or sibling nodes in Nvivo, connections between nodes being suggested by the number of cross-codings. I was, however, careful not to allow the software to dominate my thinking completely in this respect, the importance of certain data being not necessarily a function of their nodal frequency.

The superordinate themes emerging from the 42 nodes were:

1. Real-world professionalism
2. Student autonomy
3. Student motivation
4. Student relationships
5. The culture of the school and research-based learning.

It is important to stress that the intention to use these themes in the detailed discussion of data which follows was entirely to 'sensitize' (Jones, 1985: 59) the contributions of participants, to provide a 'vocabulary' for the voices of actors (Geertz, 1973: 27), and in no way to constrict or close down their responses.

4.4.6. A note on anonymity

Following undertakings given to students, teachers and school leaders and in order to adhere to university policy, names of participants have been anonymised in the thesis and the name of the school and its precise location have not been identified. Where I have used material from internal draft or preliminary school statements or reports, I have not referenced these fully, nor do they appear in the reference list. This is in order to maintain the anonymity of the authors of these documents.

Chapter Five: Discussion of the data using the superordinate themes

5.1. Introduction

The main purpose of this chapter is to delineate the conceptualisations of the student participants in the study with regard to their dispositions towards learning, their individual roles and collaborative interactions under five superordinate themes, the choice of which has been explained above. The summary of the findings of this study under each of these themes will be accompanied by a preliminary discussion of emergent theories that appear to characterise the student responses.

These responses, which are the core of the data of this study, are contextualised by examples of data drawn from school documentation, my own observations of research-based activities and interviews with teaching staff and leaders at the case study school, where this is helpful. Where appropriate, they are also further contextualised by reference to the literature, though I have been careful to do this only when it clarifies, strengthens or challenges the emerging theories from the student data itself, this being an essentially intrinsic study.

Similarly, my approach to the findings is conditioned by looking through the critical realist lens at the emergent student knowledge and understanding, being mindful, in my presentation and discussion of findings, of the necessity for an unrelenting focus on listening and attempting to understand in its own terms what each student participant has to say, in line with the methodology of *analytical dualism* associated with critical realism (see above, in 3.2., and Archer, 1998: 534).

Discussion of findings in this chapter begins with a broad consideration of one of the strongest emerging concepts from the data, the real-world professionalism of the research-based activity at the case study school. ‘Professionalism’ here is used to denote

students' appropriation of the actual goals, strategies and methods of communities of practice as they exist outside the school, in the real world. In using this latter phrase, as I do at intervals in my analysis, I am aware of its critical imprecision, schools being, of course, part of the real world themselves. I use it, however, to delineate the difference between schools as bounded communities and the life of the social, cultural and working nexus outside them, for which they have been traditionally expected to prepare young people.

From the discussion of real-world professionalism, I turn to two themes which are intimately related to it, autonomy and motivation (whether this is intrinsic, extrinsic or, as is fascinatingly revealed in this data, a complex mixture of the two). These two themes lead the discussion to that of the different relationships developed through research-based learning.

The final theme considers what students' reflections on research-based learning have revealed about the learning culture of the case study school. Students' perceptions here varied widely, and there emerged occasionally a somewhat conflicted view of how the school champions research-based learning and the messages it communicates about other academic demands. Students also gave their impressions of the school's attitude towards and provision of support, both within and outside research-based activities.

5.2. Students' conceptions of the real-world professionalism of research-based learning at the case study school

The answer to the question of whether the research-based learning at the case study school adheres to the approaches and methods of professional communities of practice in the world beyond the bounded school community emerged in very different ways in data from interviews with students, leaders and teachers. For the purposes of clarity, I

have therefore divided this part of the study into six sections, the first four outlining in increasing detail the subject-matter, disciplinary skills and methods of the students and the last two moving to comparative and more overtly critical approaches. The sections deal with:

1. The idea of student research opening up new or ground-breaking areas of inquiry and/or creativity
2. The concept of professionalisation in terms of real-world communities of practice
3. The idea of the research responding to real-world needs and/or having real-world goals, applications and end-products
4. The research methods used by the students
5. How students compared and contrasted research-based activities with more conventional learning at A Level
6. Genuine research versus low-level activities, busy work and the learning of techniques

5:2:1. Research-based learning at the case study school as opening up new or 'ground-breaking' research

Much of the evidence that research-based learning at the case study school can lead to genuinely transformative, even ground-breaking work came from the perceptions and conceptualisations of students in science and design. Thus, Student C, one of the prime movers in the LUCID project, a study initiated by students to capture and analyse data on cosmic rays using complex instrumentation from the CERN Large Hadron Collider in Geneva, used the language of leadership and innovation in the context of existing work in the space science community:

> I'm currently leading a research project based at the school called LUCID….it was conceived by students here about nine years ago – we've been gradually developing it over time since then….it's certainly not a type of data which has been collected before – there are similar experiments in terms of the aims of them, but the technology they're using has always been different….so it is the first experiment of its kind (Student C)

This leadership and innovation was there, too, in evidence from design students, but here the emphasis was on breaking new ground in the creative and prototyping process as a response to an actual brief, transformation working through initial reproduction, as this student's delineation of work on R-GEN, a hand-held device for power generation, made clear:

> [This is] research that, not necessarily hasn't been done before, but hasn't been put together in the same way, so….for our project we researched something that was specific to our brief, so….different things that had obviously been researched before, but then putting them together to meet our brief which….hadn't necessarily been done before (Student E)

This evidence of real-world engagement as a result of research and development was echoed in the words of the head of design at the school, who suggested that the company responsible for giving the students the original brief had 'that philosophy that they've almost employed them to work on this project – it's a real brief, it's not a made-up one from me that I've given them in a design lesson' (Teacher 4). Similarly, there was supporting evidence from science teachers of the high-level, innovatory quality of student research work, the former head of science at the school (Teacher 6) reporting that the work of current and former students had been so original and successful that it had been 'copied by NASA and placed on the ISS [International Space Station]', whilst

other work, using the Faulkes Telescope, had been ‘unique’, both projects leading to the publication and presentation of papers by students to members of the international space science community in the UK and abroad.

Much of this transformative innovation appeared to be in evidence in high-profile research, where students had engaged with leading scientists or companies in ‘headline’ projects. However, there was some evidence of real creative innovation in behind-the-scenes work carried out in support of the more superficially exciting projects. Thus, the head of physics (at the time of interview) spoke of

> students who may not be the strongest in physics [but who] have made phenomenal contributions in computer science to projects going on here – really phenomenal, written whole new systems which have been made available to all schools across the country (Teacher 1)

In other words, there is data to suggest that students in science and design (and to a lesser extent in humanities projects) had initiated and sustained research activity that was genuinely innovatory and occasionally ground-breaking, where, as the head teacher of the case study school has asserted, ‘students work alongside academic and professional researchers and make a real contribution to the work of the international research community’. In so doing, these students appeared to feel that they achieved, in their new dispositions towards learning, their new collaborations, their work on what Lombardi calls the ‘ill-defined problem’ (Lombardi, 2007: 3-4), something like ‘creative re-design’, the transformative shift which Archer sees as the sign of a liberating rather than constraining role-incumbency (Archer, 2000: 283, 308). Thus, these students would seem to have moved well beyond the mere ‘ersatz’ school culture (Brown, J.S. et al.,

1989: 34) in forming ‘concrete connections’ between themselves as learners and the disciplinary knowledge and skills of experienced practitioners (Lombardi, 2007: 2).

5.2.2. The concept of professionalisation in terms of real-world communities of practice

Lombardi’s ‘concrete connections’ and the escape from ‘ersatz’ school culture advocated by Brown, J.S. et al. links neatly with rich data from the student interviews on the subject of how professionalised or otherwise they felt themselves to be when working in research-based learning activities. I am using the term ‘professionalised’ here to denote simply the process of becoming attuned to the philosophies, identities and methods of particular occupations in the real world and not in Englund’s sense of overtly attempting to attain status and position (Englund, 1996: 76), though this has some small relevance in this study’s later consideration of student motivation. In expressing their conceptual understanding of being a professional, students occasionally used the word ‘insider’, and it is a word I also use in discussing their responses. It denotes, I think, the idea, and feeling, of working inside a bounded set of occupational values and methods. It is, of course, a well-known term in discussions of in-service qualitative research (see, for example, Mercer, 2007), but the word is not intended to reference the ambiguities of ‘insiderness’ and ‘outsiderness’ that surface there.

A sense of being a professional emerged in different ways from the interviews. Often, it seemed to arise simply from the habitual processes of carrying out procedures which were significantly different from those which students were used to, processes which appeared to affect students both intellectually and emotionally. This English student, for example, speaking about her research into an unusual aspect of Mary Shelley’s *Frankenstein*, reflected on the authentic complexity and precision of the critical process she was engaged in:

> you're really kind of getting to grips with their argument, deciding which parts of it you agree with and which parts of it you disagree with, and then presenting your own alternative critiques – so, in a sense you're becoming a critic yourself (Student G)

Similarly, a student involved in an unusual project examining the effects of music on Parkinson's sufferers reflected that 'getting used to having to read scientific papers and do your own research very much, kind of….you start to feel like a research scientist' (Student K)

The emotional response linked to the intellectual challenge here – *feeling like a research scientist* – was echoed by other students. This student researcher in geography expressed the emotional thrill of engagement with the serious adult world of scholarship:

> when we take trips to the archive and we are treated like adults there and we're given the books and 'Ooh, we can touch them', it feels like we're geographers….it makes me feel very adult….and that makes me feel very professional (Student O)

For some students, though, the intellectual and emotional response to being an insider extended to more intimate engagement with actual professional communities that went well beyond peripheral participation. Thus, this student communicated with fervour the experience of presenting a paper at international conferences of the science community:

> I've had the opportunity to….just sort of go there as a delegate, as any of the researchers would do, and just kind of stand up and give a talk in front of them, and that was, I'd definitely say, a more difficult thing to get into in the first place, but once you become accustomed to that it's a really incredible thing (Student C)

Other students revealed similarly powerful activities integrative with a professional and commercial community. A design student described the mutual dependency of a student-initiated project and a professional company's work schedule, such that:

> we set it up and then we contacted the company and they've sort of become integrated in it and actually one of the Year 13s who set up the project is going to work for this company during a gap year, so he will be within the company working solely on our project, so the company has become integrated into the project (Student A)

The professionalisation of student researchers was not always, however, as unconflicted and successful as these data would seem to suggest. From many interview responses, more confused and ambiguous attitudes and feelings towards being an insider emerged. Here is a student trying to express the exact shade of her feeling about carrying out her research into local history and the First World War:

> I did still feel like a history student, because throughout a lot of it I felt like I didn't really know quite what I was doing – however, at the level where I was, as I said, I was confident in what I was doing, so I wasn't….I didn't know whether I was always doing the right thing, so I always kind of wanted to double-check that we were on the right track, so I wouldn't say I felt like a historian, no (Student I)

The conceptualisations of other students were less confused but expressed clearly that their roles in their research projects constituted what one student referred to as 'a sense of a sort of limited professionalism' (Student P), their undeveloped knowledge and experience balancing the sense of independent achievement:

> I know I've only got a student's knowledge – it's trying out what it would be like to be a professional, it's sort of the step between, I guess – you're going

> beyond what a student would do, but, at the same time we don't have the knowledge of a professional researcher, so it's sort of in the middle, really (Student J)

> I think to some extent I do feel like a student, because there's so much I don't know….but then at the same time I did also feel like it was a new idea, it was an original idea, and I was really proud of that….so it's a definite mixture of the two (Student H)

To an extent, as some interviewees suggested, it is a question of a resistant embedded identity. Student E noted that, despite sitting in front of company executives and demonstrating her group's design ideas, 'it was like….a row of 16, 17-year-olds sitting there against like adults….it felt like a project, it felt like a school-related thing'.

This evidence suggests that, with the exception of a relatively small number of students who had truly integrated their work with actual professional communities, professional insiderness for most students existed in the context of what Lave and Wenger describe as 'peripherality', where involvement is 'legitimate' and participatory but limited in its scope (Lave and Wenger, 1991: 115), an 'approximation of full participation that gives exposure to actual practice' (Wenger, 1999: 100). In this context, research activity becomes both a protected and a scaffolded process but, echoing Bhaskar's scheme, still open to 'reproduction, transformation and change' (Lave and Wenger, 1991: 123).

5.2.3. Student research responding to real-world needs and/or having real-world goals, applications and products

This quality of being able, despite the limitations of peripherality, to reproduce existing research activity and transform it (in however small a way) was also felt in students' responses to real world needs and the possibility of professional applications and

products. This student, responding to a competition-based technological brief, demonstrated just this ability to begin by reproducing the structural demands of the brief and to continue by transforming the exercise through genuinely addressing a pressing need and producing a prototype device:

> we had to research a community that might be affected by natural disasters and find the problem that they had, so for us we chose Indonesia – a city called Medan, and we found that they had very poor infrastructure in the city and this meant that even not very powerful earthquakes would cause their buildings to collapse, and they didn't have the money to build earthquake-resistant buildings, so instead we came up with a solution where people could wear wristbands and, when people enter into the building….it would activate….and we had to research how the technology would work, and I ended up making a prototype for it as well (Student D)

For other students, responding to real world needs and devising applications that might address them ran parallel to the research process itself, rather than being the initial driving force behind it. The ground-breaking student research on cosmic rays in physics, for example, seemed to have been driven by an abstract desire to explore new knowledge in the space science field, but, as Student C explained, the work had 'significant real world….applications' in predicting the effects of solar storms.

Student K was initially driven by a desire to find out more about the effects of drugs on receptors in the brain as part of the preparation for his chosen university course, but, through this, became interested in how Parkinson's disease affects brain function and went on to link his love of music with his research through the idea that singing might release curative dopamine in the part of the brain called the stratum. This interest led him to carry out a controlled field study with a group of Parkinson's sufferers who had formed a vocal ensemble, to see if the singing might improve their symptoms.

Students D, C and K, in their different ways, exemplified powerfully the definition offered by Newmann et al. of the most effective authentic learning processes following their evaluation of projects in 23 US state schools, the 'construction of knowledge through disciplined inquiry to produce discourse, products or performance that have value beyond success in school' (Newmann et al., 1996: 287).

There was general agreement amongst the students interviewed that having some kind of end-product, whether this be a physical object, a talk to professionals or a published paper, is an important element in professional research work, though they varied a little in the conceptualisation of this importance when compared to the research process itself. Student A, whilst acknowledging that the research aims of the CERN-at-Sea project were 'dynamic and changing', nevertheless offered the view that 'if we hadn't really known what we were going to do with that data we wouldn't have been so driven to keep going'. For Student D, it was the physicality of making that was the determining factor, 'making an actual physical thing….as if you're working on something that's actually something in the real world, whereas if it's conceptual you might be less motivated to work on the project'.

This student enthusiasm for product-orientated research was acknowledged by the case study school's head of design, but he cautioned against their seeing it as the only benefit to be gained from the process, pointing out that, ultimately, the research skills themselves were more important than, for example, the success of a prototype:

> the students want to work in prototype, otherwise I personally believe they feel it would be a failure, but actually it wouldn't be – if it fails, which happened a couple of years ago, the project was more successful because the students got a lot more out of it, and they kind of knew where they went wrong (Teacher 4)

5.2.4. Student research methods and real-world professionalism

The different attitudes and approaches to real world needs, applications and products were echoed in the variety of evidence on student research methods from the interview data. In some of the research activity, there seemed to be a systematic approach that was carried through to the end of the project with very little evidence of structural or methodological variation, but evidence from other students suggested that, as in most complex research processes in the real world, initial structures must adapt under the stress of actual retrieved data. Student B described this process in his gathering and analysis of data in the historical geography project examining evidence from pollen grains to determine patterns of human habitation and development. Evidence of charcoal deposits in amongst the pollen was taking the group down one interpretative path, only to find 'quite a few different grains which were….suggesting the opposite'. It is interesting how, in his interview, he was able to stand back and, with the aid of an American sporting metaphor, conceptualise what this tells him about the research process:

> I suppose within the project as well – like you'll get a number of results and you might think, it's going down this route, but then suddenly a big curve-ball comes at you and you have to think about it in a completely different way (Student B)

Other students, though, detailed rather more chaotic research methods, perhaps the result of less than adequate support mechanisms and procedures. When Student K began field research on music and Parkinson's, for example, his approach was somewhat ad hoc and ill-informed, his use of a questionnaire being loosely planned ('when I drew up this questionnaire, I wasn't exactly sure what I was investigating'), and his information about the number of Parkinson's sufferers in the vocal ensemble inaccurate. Likewise, another student's, in many ways comparable, research methods in investigating the effects of

chess on dementia sufferers in care betrayed a lack of awareness of ethical and other issues in a similarly loose approach:

> I emailed a care home asking if I could teach chess, and I definitely favoured towards like the fact that I just want to teach chess and….yeah, so it was a bit dodgy, but I mean I did mention that it was part of an EPQ as well – I'm not sure if they knew what I meant, and so I actually went to the care home, talked to the patients – 'residents', I should say residents, to be perfectly correct – yeah, about forty residents there, with different levels of dementia – I think some of them don't even have dementia (Student M)

In terms of professionality, this evidence is ambiguous. To an extent, the fact that students discovered that research is a messy business in which it is sometimes necessary, despite meticulous planning, to respond to disorientating 'curve-balls' indicated that theirs was a validly rich and complex experience, reproduction of planned structures and methods leading to other, unexpected, emergent and transformative knowledge. On the other hand, the experience of Students K and M would indicate a less professionalised, more chaotic and ethically unsound approach which might bring into question the adequacy of the advice and support provided by the case study school.

5.2.5. Student research-based learning and conventional learning at A Level

When students at the case study school reflected on the real-world qualities of their research work, they often referred, not to how new, professionalised or methodologically challenging their research had been, but to how different the work they had carried out was from more conventional learning in their A Level classrooms.

The head teacher of the school, in his tentative written account of the school's developing pedagogy, distinguishes between a 'traditional "standard model" of teaching' and '"scaffolded" models of learning', going on to assert that the development

of the school's learning philosophy 'exposes the dichotomy between these pedagogies', something echoed by the head of research at the school (Teacher 5) in her interview with me, when she described research-based learning as 'a vehicle for growth of students and stretching them beyond the constraints of a very narrow, almost box-ticking curriculum that we have to deliver and that universities see through'.

The phrase 'standard model' was rather loosely defined, in the head teacher's interview with me, as 'the teacher delivering learning to people', but it is clear that the meaning of 'scaffolded' here is closer to that of Vygotsky's *zone of proximal development*, with its emphasis on future independence (Vygotsky, 1986: 189) and to Bruner's later emphasis on liberating autonomy as the end result of scaffolding (Bruner, 1996: XII) than it is to more constricting forms of scaffolding used to tie learning to syllabus requirements (see Moore, 2012: 19).

This was the local context in which students' understanding of the distinctive qualities of their research-based learning, as opposed to their learning in A Level lessons, had to be set. It prompted the questions of how dichotomous the two forms of learning were perceived as being in the views of students, how 'stretching' their research-based learning was and how 'narrow' students felt their A level syllabuses and learning methods were.

In responding in the interviews, students often focused on the use of time as a distinguishing factor in thinking about research-based and more conventional learning. Student Q, for example, saw syllabus-driven learning and testing as about 'what can I remember on the day?' as opposed to 'what skills can I develop over time?' Student R, similarly, felt that the research he had been involved in (the design of a water clock currently installed in a public space) necessitated planning and deadlines that were

‘much more long-term than….short-term’, allowing students to ‘work through each bit at [their] own pace, and….go through stages in developments, [their] own pace and [their] own level’.

Because of this longer, more flexible time-line, several students offered the view that their research-based learning had depended much more on a genuinely independent re-thinking of approaches and a corresponding creative expansion of ideas than had been the case with learning in their A Level classes. Thus, in reflecting on her polymer research in Chemistry, Student N was aware of how much of it depended on self-generated learning, unlike the constricted approach she had experienced in A Level Chemistry:

> when we’re doing our research sort of we just get on with it, we make our own mistakes, learn from our own mistakes….but, in lessons, it’s sort of already done, you’ve got to do it like this, you’ve got to do it like that, make sure you do it like this, don’t do anything different

Student A articulated how this freedom and responsibility had led to the potentially transformative generation of new meaning:

> ….you can go out in all directions and it’s constantly expanding and bringing in new aspects of it….whereas A level you’ve got to get those grades, you can’t expand outwards, you’ve just got to keep going

Even when aspects of the A Level syllabus appeared to offer more of an open challenge, several students were of the opinion that the more genuinely liberating freedom had come in their research projects. Here, Student I described the restrictive requirements of her history coursework:

> [In] history coursework, you do have to follow the rigid kind of….you have to come to a certain conclusion, you have to evaluate it in a certain way, you have to have a for, you have to have an against….

She went on to describe, by contrast, the liberating altruism of her research project, in which 'learning is a lot more free, because, you know, no-one's judging you on it, you're just offering something for someone else'. Fellow history student, Student P, neatly summed up the distinction between student research and history coursework in terms of learning dispositions: 'one gives you freedom and one just binds you to the restrictions of the exam'.

One might say, in fact, that these responses characterise the two forms of scaffolding discussed above – the form which looks to support the learner with an eye to freedom and challenge through proximal development and the form which reifies and atomises students' urge to explore and analyse with a view to the successful completion of an examination syllabus, as in the structural constrictions of history coursework, constrictions felt, equally, by the teacher leading both the history coursework and the research projects at the school:

> the history student will always kind of be told you've got to analyse and find an answer where there is no answer, but ultimately there's a kind of spectrum of answers that are within reach….and that reach often isn't that far away from Google or a text book or a teacher, but here [in research-based projects] they really don't know where the avenue actually is (Teacher 3)

Several students revealed in their interviews an understanding that this greater flexibility, challenge and possibility for transformative change required a different mindset (a word freely used by many students) from that employed in the successful completion of A Level courses, a shift from the 'fixed' to the 'malleable' view of

cognitive ability (see Dweck, 2000: 2-3). Student C, a leader of much of the high-level work in the cosmic ray detection and analysis project (LUCID) in physics, articulated the nature of the transformative challenge to conventional reproductive attitudes he saw when other students joined the project:

> one of the problems that you get sometimes is that people, having been through school for lots of years, expect to be taught, and they just say kind of, well, what do you want me to do, how do you want me to do it, but I think everyone does enjoy it a lot more when you just get into that mindset of 'actually I decided for myself what I want to do and how I want to do it, there is no manual, textbook or any teacher who can tell me exactly what the right way is to start doing it….'

This change of mindset was a difficult idea to conceptualise for some students, but Student B found a powerful phrase – 'hard thinking' – to describe the personal commitment to creative problem-solving involved in moving away from straightforwardly 'putting in the time' and 'getting the information into your head'. For another student, looking well beyond her local context, the commitment described by Student B represented what all learning should be about:

> I just feel like it's the basic idea to learning anyway, I feel like learning should be about what we do here rather than about passing exams….and I think that idea should be central to every school, regardless….it should be about whatever it is you're doing, like loving it and wanting to create new ideas (Student H)

The experiences described by these students are close to the kinds of transformative change described by Jack Mezirow, when we 'learn to negotiate and act on our own purposes, values, feelings, and meanings rather than those we have uncritically assimilated from others' (Mezirow, 2000: 8). Mostly, this change is what Mezirow calls 'cumulative', the gradual acquisition of new frames of reference and skills over time, but the kind of shock to the system described by Student C above is akin to the more

sudden change experienced in the 'epochal' moment, when understandings and dispositions shift suddenly and dramatically (Mezirow, 2009: 94).

From the responses given by these students, there was evidence of scaffolded approaches at the case study school being more hands-off than hands-on, contrasting with the more constricted environment of the A level classroom. In this sense, the head teacher's assertion of a dichotomy between the two forms of learning exposed by the school's pedagogy seemed to be supported. However, it is worth questioning whether this dichotomy was complete, or whether there was a sense in which some students were able to transfer approaches and skills from one form to the other.

Students A and B were tentative about any such transference. Student A related that he still found, despite experiencing sustained learning in both forms, that he put the research-based learning 'in a sort of box', yet offered the possibility of some transfer to his approach to A Level ('I don't know whether subconsciously elements of it may sort of filter through'), whilst Student B seemed to suggest that there must be some transfer, not only between research work and A Level, but between research work and a broader capacity for questioning, though his 'you'd think' was still somewhat equivocal:

> ….if I wasn't doing research, then I wouldn't be questioning different things within that, so then you'd think that would probably transfer to, not just in lessons, but in general as well

Other students, however, were more unequivocally positive about the possibility of transference. Student G, part of the *Frankenstein* project in English, was articulate about the degree to which research-based learning builds a reflexivity based on what Grolnick and Ryan call an 'internal locus of causality' (Grolnick and Ryan, 1987: 897), turning

the critical ear inwards and enabling her to transfer professional skills to her A Level work:

> ….it feeds into the A level in just generally training your mind to be more critical and to be more critical of yourself, and not in a negative way, in a kind of way where you say, 'Actually, if I wrote down this argument, and actually someone else had written it….and I was going through it and critiquing it, what would I say that's wrong with this, how would I criticise my own work, and it makes you much more able to do that

What we can learn from this evidence is that it is natural for students to reflect on the distinctive, professionalised, real-world qualities of their research-based learning by reference to the other forms of more conventional learning they have been used to for many years, and which is still, despite the statements about independence of thought and action in A level syllabuses, prevalent in the sixth form. The interview responses suggested that the head teacher of the case study school is right in his assertion that there is a marked contrast between standard approaches to classroom learning, resulting in a constraining, 'inert' knowledge (Brown and Palincsar, 1989: 394), and the kind of pedagogy supported by research-based learning, a cultural dissonance close to that implied by Bruner (1996: IX). However, it was apparent that the dichotomy between the two was not as stark as he has suggested, some students discovering a two-way exchange of skills between the different forms of learning and realising that a fundamental understanding of underlying principles and theories – the reproductive element – can be crucial in making sense of emergent knowledge – the transformational element. Research-based learning, for the majority of students interviewed, provided flexibility, freedom, extended use of time, the development and expansion of knowledge and skills, along with the weight of real-world challenge and transformative change (in Mezirow's sense).

5.2.6. Genuine research versus low-level activities, busy work and the learning of techniques

These positive aspects of research-based learning, however, did not go unchallenged at the case study school, and interviews with both students and teachers revealed what might be seen as less intellectually stimulating processes and outcomes in certain projects.

Student O, as someone who had been involved in two separate research projects, the myelin basic protein (MBP) project in biology and the polymer project in chemistry, had some interesting reflections on the research she was involved in:

> I guess what we're doing there [in the polymer project] is less ground-breaking than….MBP cos it's looking at how much each polymer expands when it absorbs some solvents – it's not the most inspiring thing, but it does feel like we're producing actual data, whereas MBP is much more ethereal

Clearly, for this student, the ability to produce data within a small group of student researchers represented a more rewarding experience for her than the more 'inspiring' work of the project in biology (a project which aims to contribute to the discovery of a cure for multiple sclerosis by exhaustive research into the behaviour of certain proteins). This was partly to do with the numbers of students involved, but, as this comment from another student involved in the MBP work revealed, there might also be an issue with the goals of the project:

> The goal is always to make the next ground-breaking discovery, so you always have a goal, really, but we don't really have a hard-set goal – this is what we want to accomplish – we do want to find the cure, but we're not working towards the cure, we're working to find the cause of….we do want to find the cause, but we're not saying by the end of this year we want to have found the thing that

> causes it, we're just….the goal is really just to investigate and further our knowledge (Student J)

The struggle to conceptualise clearly the precise goal for students working on this project, inspiring and important though it undoubtedly is, was revealing. Student M, speaking about the same project, went further, suggesting that 'there's no real hypothesis, no real aim of the project' and that part of the problem was the repetition of tasks by new sixth form students arriving in Year 12 that had been carried out before ('they stick to what they know….and there's no real research being done at all, really').

There was, perhaps, a sense of one or two research projects being kept simmering without moving forward as strongly as they might because of funding arrangements (the MBP project is supported by the Wellcome Foundation and funding depends partly on numbers) and the desire to be part of what the school has encouraged as its dominant pedagogy. Also prevalent is the fact that students provided a ready workforce with which to continue research projects undertaken by teachers at university or currently in the throes of huge data analysis programmes. This last tendency, described by Teacher 8 as treating students as 'lackeys' in their work on prestigious physics projects, was referenced, directly and indirectly, by several students, teachers and leaders. Student O, for example, commented that 'it does feel like we're just doing the work' in the MBP project, and revealed the disconnection between work she had carried out and the significance of the results and outcomes that might be understood by the teacher running the project:

> ….there'll be things that he mentions that he doesn't like expand on, I guess….I guess I don't see the way that the things he's found out translate into what we do in the MBP, or what I do necessarily translates into the results

This danger, of students being used to accumulate data or carry out straightforward analysis – reproduction without any real possibility of transformation – appeared to be one understood by the head teacher of the case study school as he described in very forthright terms the early failure of another science project:

> ….not a single student has signed up for that project – why? Because [the teacher leading the project] knows the answer, and the students, you know, they say, I'm not a lab technician for a teacher who wants a little bit of attention for this and the students are savvy enough to realise, no, this is crap – I'm not doing this

Some of the interview data suggested that this tendency to supply students with what is referred to in Nicaise et al.'s empirical study of a space science programme in the US as 'busy work' (Nicaise et al., 2000: 91) rather than full research activity puts too much emphasis on learning techniques rather than on evaluative and creative skills. In Lave and Wenger's terms, this is legitimate involvement weakened by activity which is too peripheral and lacking in full, rich participation (see Lave and Wenger, 1991), a point summed up in the comments of the former head of science at the case study school about students' work on the MBP project:

> Students did very little research on their own and seldom developed their own ideas; they were more in the role of lab assistants. Here we must distinguish between research based learning and using new techniques. They are separate entities and must not be treated as the same thing (Teacher 6)

He also writes about students on this project at times 'doing nothing, waiting for things to happen', with the result that their 'knowledge of science was not greatly enhanced except for the few who really committed themselves'. This last observation raises another issue in terms of the value of the research for the majority of students who have become involved with it. In his interview with me, Teacher 8 reflected that it was

probably a ‘very, very small number’ of students in science research projects who had become genuinely and fully involved in high-level research, the rest just hanging ‘on the coat tails’ of exceptionally gifted students.

My own observations of a range of student research groups partly supported this idea: there were certainly hiatuses in the processes involved in the research work I saw being carried out in biology, history and music, but the picture was, I think, complex: sometimes natural pauses in the work were occasioned by temporary blocks – students waiting for information or for other students to complete their work – and this appeared to be, in itself, part of a pattern of real-world research work which did not follow the more uniform patterns of conventional learning. On the other hand, I became aware of the contrast between students who were forging ahead with their research, thinking as researchers and making the most of opportunities afforded by archives and primary evidence (in both history and geography groups, for example), and those who seemed, when questioned, to have very little idea of what was going on, or to be following the lead of others. Students in the former group, however, were much more numerous than ‘a very, very small number’ would suggest.

5.3. Student autonomy

Unsurprisingly, given the nature of research-based learning, the ability of students to work autonomously was a central theme in the documentary data and interview material from leaders at the case study school, and especially in responses from the head teacher.

The words *autonomy* and *autonomous* occurred throughout these responses, and the related concept of *independence* appears as one of the central ‘attitudes and attributes’ that form the core of the school’s educational approach, though it is interesting that it is

coupled with *collaboration*, a coupling that relates to some of the evidence from student responses I shall explore later in this section.

In his draft document on pedagogy, the head teacher sketches out the school's approach to learning as not accepting that the change from *pupil* to *student* must begin at university, school learning being typically about 'compliance, dependence and acceptance', but instead as moving school students on, in and before the sixth form, from 'heteronomy and dependence to autonomy and independence' through a transformation that is 'deep, personal and internal'.

These are interesting comments, suggesting, at one and the same time, that shifts in student dispositions to learning are transformative, in Mezirow's sense of an affective personal change which is at least 'cumulative' if not 'epochal' (Mezirow, 2009: 94), and that students begin by heteronomously adhering to existing reproductive patterns of learning before moving to autonomous patterns through the liberation of a freer, research-based pedagogy.

The mass of evidence from the interviews with students on the subject of autonomy tended to cluster into three categories:

1. The degree to which students initiated and/or were in control of the research they were engaged in, and the nature of the scaffolding they received in support of their independence
2. The way student autonomy actually manifested itself in the research processes in which students were involved, and
3. The question of whether or not *all* students involved in research-based learning achieved, or even desired to achieve, autonomy.

5.3.1. Student initiation, control and the scaffolding process

Before embarking on an analysis of different conceptualisations of autonomy that emerged from my interviews with students and teachers, it is worth saying that, from the evidence of those same interviews, there is little doubt that the case study school's efforts to establish autonomous learning amongst students at the school was founded on a desire to empower them.

Thus, Teacher 1 admitted to being 'furiously determined' to 'empower people to be scientists' and to counteract the 'hierarchical thing' of a dominant academy:

> I feel that students don't need to be in that position, that the whole of sort of learning and research and innovation should be a property of everybody

Student C, a leader of the LUCID project in physics, gave utterance to just what this empowerment could mean when it enabled students to strive towards

> ….that kind of completely new thing….just the fact that you don't know what could possibly come out of it, but it's very exciting, because I mean it could ultimately be a failure and you don't find anything, but just the possibility that you could, and especially at a young age when it's a pretty impressive thing to do that, just to have the possibility that you might find something that's actually quite important no-one else has seen before does just drive you from day to day

From the evidence of the student interviews, however, this empowerment has led to three different outcomes in terms of how students have embarked on research activities and expressed or attained different degrees of autonomy.

The first of these, attained by a significant but relatively small number of students, was a directly innovative response to an opportunity the school had facilitated, a response unmediated by teachers or outsiders. Two very contrasting examples of this kind of

epochal autonomy came from research in space science and an outraged reaction to what a group of students saw as indefensible censorship.

The foundation of the LUCID project in physics, to which this study has already referred several times, clearly owed much to the context of collaboration between the school and the scientific community at CERN, but the initial idea was entirely down to students' innovative thinking, as Student C recounts:

> ….some of the students just had an idea – well, have you used this kind of thing in space, because these things must arrive from somewhere – the kind of particle interactions from the sun and from elsewhere, and presuming that the answer would be yes, and kind of wanting him to explain how they'd done it, but it turns out that no-one at CERN had had that idea

Similarly, but in a very different context, the response of a group of a dozen students to the forced cancellation of a presentation by an alt-right former student was initially wholly unmediated, yet highly professional. The head of humanities gave his account of this phenomenon thus:

> ….it quickened and enlivened the atmosphere round here when it comes to issues of free speech and censorship and I think a lot of the kids who were already politically inclined became more so….I've seen….students who are still buzzing from the incident….they come by here all the time, to plan the new symposium, to bring out their own book (Teacher 7)

In both of these examples, there was an initial empowerment as a result of links forged with the support of teachers (though student involvement, even at this early stage, was strong in both cases), but immediately a student response which gave expression to an autonomy that was raw, energetic and untutored.

The second outcome of empowerment, attained by rather more students, was autonomy quickly established within a tighter guiding framework already in existence. This was succinctly expressed in the philosophy behind Teacher 1's liberating research in physics: 'give them the tools….and then let them run with it'. This is research activity which is not wholly innovative, happening within closely structured boundaries, but which nevertheless allows for *ab initio* autonomous student involvement, as Student C explained, with regard to his leadership of neophyte student researchers in science:

> I think it is important to give people freedom right from the start….even if they don't know where they or how they're going to start getting into the work, just take from the start what about the project appeals to me, what would I want eventually to be working at and then kind of work with each of them on a one-to-one basis

In the humanities, the autonomous setting up by students of subject-related societies also clearly occurred within a supportive framework of strong subject leadership from teachers and a culture of existing, non-student-run activities, but clearly made its own distinctive mark, as the head teacher of the case study school commented:

> ….nearly all of the societies that we have are now student-led exclusively, and those that are most exclusive to students are the most successful. The….Politics Association, the Faculty of….Economists and the Feminist Association are the three most successful this year – they've put on conferences, they've had high-level people and no teacher has been involved in any way at all

The third autonomous outcome of empowerment shared the sense of happening within a strong, supportive structure but involved students who were, from the evidence of the interviews, less able to make an immediate impact on the area they were researching, although they moved gradually towards a fuller autonomy. In other words, they began,

in critical realist terms, by reproducing what had been given to them before developing the autonomous confidence to transform it. Thus, Student B, speaking about her practical historical geography work, reflected very straightforwardly on her gradual growth of independence through learning by 'doing it':

> ….at the start, when we were analysing our slides, we were asking like for confirmation of this – is this a certain type of pollen? – but within a few months, we were just doing it and we just knew which one was which and we didn't need to ask any more

What is particularly interesting about these responses is what they reveal about two different models of autonomy prevalent in the literature, autonomy as inherent human quality or capacity and autonomy as a goal, or something that needs to be actively fostered. Smith refers to these models as, respectively, the 'strong' and the 'weak' (Smith, 2003: 130-131). In this, he is aligning himself with the approach of Jean Lave and Etienne Wenger in their emphasis on legitimacy (see Lave and Wenger, 1991: 29, and Wenger, 1999: 100) and with transformation theory, with its emphasis on action and decision-making according to personal meanings (see Mezirow, 2000: 8).

For one student, though, this distinction between strong and weak models was questionable. Here she articulated very clearly how, for her, it was a question of drawing out of individuals a natural disposition to think and act independently which is there but needs to be liberated, a liberation which can bring about the transformational change discussed by Jack Mezirow:

> I'd like to think that everyone's capable of it and that it is inherent in everyone, and I guess that's kind of what the system is designed to do, to just sort of gradually tease it out of people and allow them to come up with their own ideas….but I think in the end it is sort of a goal for everyone at the same

> time….because it's something that I'm definitely working towards, more so because I can see in myself there's been this gradual change and I have become more autonomous (Student H)

The key to the change here is the reflexivity of 'I can see in myself' – it is this that leads to the transformation, not the separate creation of a hitherto non-existent skill-set.

The 'gradual teasing out', though, is also crucial, representing the process of proximal development ultimately focused on conceptualisations 'formed by the student himself' (Vygotsky, 1986: 152), and the degree to which scaffolded support from the school, teachers, more experienced fellow students and outsiders was sympathetic to learner autonomy emerged as a clear theme in both student and teacher interview responses.

In describing his scaffolding strategy at the very beginning of projects, the head of design reflected on the degree to which support in student design research aligned itself with the prevalent culture of both school and subject:

> I have a philosophy of having quite open design groups for a reason, because….I know the type of student that we're going to create….architects, engineers, designers, industrial designers, and I allow them to do what they're best at (Teacher 4)

The support here is in line with the 'situational leadership' described by Higgs, the teacher-leader adjusting her strategies and methods to take account of how ready the students are to take responsibility for their learning in a particular context (Higgs, 2003: 55-56).

In such an open initial environment, though, as several students have pointed out, it is vital to receive the reassurance that progress is being made in a positive direction. Here,

Student E asserted both her own independence as researcher/learner and the need to receive constructive support and criticism accessed by the student herself proactively:

> I think….it is possible to get sort of reassurance that it's going in the right direction, more than you need support in what to do….there is support available, but you have to go out and get it…. it's not so much forced upon you, it's a lot….if you get stuck, it's up to you to get help, otherwise the project doesn't move anywhere

This response came in a group interview with three other students in which there was an interesting exchange about whether there should be closer, more protective support from the school and from teachers providing guidance for the projects. Student E reflected that she had received more suffocating support at her previous school ('they wrapped you in cotton wool'), and that it appeared that the same kind of support remained in place in the sixth form there, with 'support plans' and 'advisors' who 'don't let you fail', whereas the support at the case study school was more 'sink or swim'. This notion was picked up by Student P, whose use of the word 'brutal' is interesting, though he goes on to use a memorable and evocative simile which suggests that the case study school would be there to catch you in your fall and encourage a more independently reflective attitude:

> ….linking on to the point about letting people fail, I think the school is somewhat brutal in a sense, I mean it's a bit like when you're climbing….like you've got that slack rope – it'll let you fall, but it'll hold you there at the end, and then sort of think….right, so this is where you are, look at your situation – how have you got here, and then it'll actually put measures in place to actually help you do that

There is a dilemma inherent in these observations, that too much support can be stifling and inefficient in preparing students for the putatively autonomous context of future

learning, whether at university or in work, but not enough can at least appear to be 'brutal' and accepting of failure. The interview data suggested three solutions to this dilemma: differentiated support; just-in-time support and scaffolding that is gradually dismantled as the student progresses.

The following responses, from two teachers with leadership responsibilities for research-based projects, demonstrated that a differentiated approach must pay attention to both the existing dispositions of individual learners and the extent and quality of their experience. The head of design used the workshop as an example of an environment for which different approaches must be adopted:

> ….some students have no knowledge and they get straight into the workshop, for instance, and they're naturally practical and they make mistakes and they learn from the mistakes, where others need that structure before they even approach the workshop….it varies from student to student, there's no winning formula for all (Teacher 4)

The lead history teacher showed a similar grasp of situational leadership, allowing student research groups free rein in choosing aspects of the broad subject, but then using careful observation and awareness of the skill set of each individual student, the 'tutor's theory of the learner' (Wood et al., 1976: 97), to guide the degree to which he adopted a teacherly approach. What was particularly interesting in this response was the way in which the teacher, whilst responding to the needs of the group, retained an awareness of the overall autonomy towards which the support he was providing was moving:

> [The support is] very much mixed - some I've had to have so little personal, you know, teaching….hardly anything – the theatre group in particular is one that is kind of the weaker group….I've deliberately tried to hold back on answers, in

> their case, but I've had to direct them and that has been more of a traditional teacher-student relationship, I'd say (Teacher 3)

For other teachers, it was sometimes a question of providing, or collaborating in order to facilitate, knowledge or skills at exactly the moment when they were needed, rather than front-loading these, a just-in-time, rather than just-in-case, approach. Notice, in this account from the head of physics, the relaxed switching of roles from individual to collaborative:

> ….trying to access certain things for them, like the new CERN At Sea project, we've had to look into loads of stuff which….you know, we didn't know the state of radiation monitoring in the oceans and so we had to look up loads, and we did that, some together, some separate, you know, part of a team (Teacher 1)

For one student in geography (Student Q), though, the solution to the dilemma of too much or too little support was for the teacher to provide scaffolded, intensive skill training at the start of the project, what Feuerstein, Krasilovsky and Rand describe as 'instruments of adaptation and learning' (Feuerstein et al., 1978: 206), and then to allow this to drop away as a natural process of increasing familiarity and confidence led to greater autonomy, a strategy in line with Higgs' idea of the 'deliberately ironic' framework of a structure ultimately designed to free students from the constraints of that structure itself (Higgs, 2003: 53). However, it was interesting that the freedom granted and taken was not complete, the student being clear that it was still necessary to rely on a sense of being reassured:

> Initially, yeah – I would say it was definitely we did have to lean on her, just cos we came in not knowing, for example, how to use the archives, or how to use

> the online newspaper resources….after that it was a lot more independent, but I think there was still that element of, are we on the right track, are we heading towards where we want to go? (Student Q)

5.3.2. How did student autonomy actually manifest itself in the research processes in which students were involved?

This section describes and discusses interview responses which had to do with autonomy as a process, as a set of strategies and practices, rather than a starting point or 'point of arrival' (see West, 2014: 177). This process manifested itself in all three models of student initiation and control referred to above, unmediated student initiative with minimal scaffolding, innovation and control within a given structure and the gradual working towards autonomy from a largely heteronomous base.

Many, but not all, of the student interviewees had been involved at some stage with teams, whether at the start of projects, intermittently or throughout, and they had some thoughtful reflections on how the strategies and practices of autonomous and collaborative processes engaged with one another.

A minority of student interviewees actually expressed a preference for working alone, Student H choosing the subject area of her research partly because of this preference and thus avoiding the group dynamic altogether ('….one of the reasons why I like doing English is it is quite a solitary thing'). Others were more equivocal about the advantages and disadvantages of collaboration. Student B, for example, whilst enjoying working within a group, showed an awareness that full, uninterrupted autonomy can be beneficial, as 'if you kind of go down a certain path you can choose to go that way without having to confer with anyone else'. This idea was fleshed out a little more in

this student's reflections on the point at which collaboration might be useful and on the later stages when it could dilute the urge towards a kind of pure independence:

> I'd say that, while it is productive in the preliminary stage….to discuss it with others, I think if you actually go and co-operatively work on a project, it ends up in….forcing you to compromise on what you're actually ending up doing….so I think autonomy actually gives you the ability to follow your own personal goal of where you want to go down, whereas….co-operative work only results in a sort of compromise of both ideas, so to speak (Student P)

This reflection is broadly in sympathy with the findings of Blumenfeld et al.'s meta-study of project-based learning in the US, where there was some evidence that 'reliance on others as resources' can decrease 'personal responsibility and independent thinking' (Blumenfeld at al., 1991: 377).

Another way of considering these issues emerged in the interview with Student C, however; here there was an understanding that a disproportionate personal attachment to particular fields and newly minted ideas in the end could militate against the kind of richness that the energy of (in his case) fifty people working collaboratively could provide:

> I mean you always….have when you are partially autonomous in a project like that, kind of your own pet things and you don't want other people to touch that one bit of code that you're proud of, or something….you always feel it a little bit inside your own head, but you can kind of treat it rationally after all, and think actually in terms of the general project this isn't achieving anything and you just get so much more out of just talking over ideas with other people, sharing the work between them, and you still can keep the kind of individual aspect that you're working on to yourself in that way

This latter point, that collaboration, if based on a respect for others' standpoints and a sharing of ideas, enables the student researcher to retain her autonomy, was discussed at length by Student E. She was also in a leadership role, but at the head of a design team working to an industry brief, and so was in a position to direct the interactions of the team members, be more in control of the autonomous and collaborative elements and understand their mutually enriching influence:

> I was the team leader, so then from that I would sort of delegate tasks like, OK, you can go and research pedal electricity, you can do electro-magnetic induction, and so from that we did work quite independently and then….we'd get back together and talk about what we'd discovered, and with that came "this won't work, this won't work", so I think it was quite good because we could split off and we didn't feel like we were being suffocated….I think in a way it works quite well to have the independence and the team work together because it means you get a better product at the end of it

This is precisely the 'perspective-taking and accommodation to others' ideas' and the development of discourse within a disciplinary language code that Blumenfeld et al. find so positive in their overview of PBL in the US (Blumenfeld et al., 1996: 38-39).

Another student, Student A, speaking about his work on pollen grains in geography, summed up this powerful autonomy-collaboration dialectic as 'the best of both worlds', with time for intensive independent work, for sharing that work and for working together on the same material or idea, so that collaboration never 'robs you of the independent side'.

On occasions, it appeared that this easy fluidity of working incorporated the teacher involved as well, so that the distinction between the older, more experienced researcher and the neophyte student researcher disappeared altogether:

> ….they're more ready to make decisions for themselves, so rather than constantly asking you is this right, is this right, is this right, it's, "ooh, I think it's this, could you check that for me,"….and the idea that I don't know the answer comes out regularly, because they'll regularly find grains that I can't identify and so we have a, you know, little discussion about what it might be (Teacher 5)

This mirrored very directly the 'organic', non-hierarchical quality of knowledge creation described by the head teacher in his interview with me.

What has occurred in these groups is, in critical realist terms, emergence – observations, analyses, conclusions and ideas emerged from the work of individuals within the collaborative partnerships and these became established within the group, such that a *morphostasis* occurred. However, these nodes of developed material were then challenged by further work, new material and further discussion and a process of *morphogenesis* transformed the previously settled order of things and new ideas, structures and relationships emerged, as we heard in the contributions of Student E and Teacher 5 above.

The same process of emergence sometimes happened within the reflecting individual, a kind of internal, micro-emergence. Often, a path was established, material was gathered and ideas began to establish themselves, but things went wrong and, as Student D put it, 'going wrong is part of the learning'. In interaction with others, particularly those providing guidance and support, not only the settled ideas, but also the affective reaction to criticism needed to be transformed, such that feedback which was 'constructive, but also very critical' enabled the student to change herself from 'taking criticism in a bad way, to taking it in a really good way, and using it to fuel [her] ideas, and [her] kind of

determination' so that she felt 'much more capable than [she] had previously thought' (Student G).

It would be, of course, unusual for any transformative process to happen without some discomfort or disorientation, and the responses from students in the interviews certainly revealed the pressure individuals have experienced when moving (however quickly) from heteronomy to autonomy. For Student L, the pressure came in realising that the path of the research was untrodden, and therefore that, when a problem occurred, 'there's not a lot you can do other than solve it for yourself'. Nevertheless, for this same student, one of the ground-breaking LUCID team, there was also a sense of achievement in facing up to a challenge, leaving the individual with ambivalent feelings: '….it can be confusing, disorienting, but at the same time it is definitely a positive thing'. This ambivalence was also there in the words of Student E, who reflected that the pressure during her design project was continuous, but ultimately, because of the autonomous and collaborative elements, worthwhile:

> ….throughout the whole scheme it was quite like, oh, no, this is really stressful – there was a lot of times when I would be up really late doing presentations and stuff like that, but it was good, because it was a good kind of pressure – because I was doing it for myself and the team

As she attempted to conceptualise the epochal transformative moment, Student G echoed the feelings of Student E, but here the process of getting beyond the stressful elements was all about the quality of the final product, in her case a published essay:

> ….uncomfortable and disorientated are good words to describe it, but in a good way, in the way that I think every student needs to feel when they're learning something new….so you go through a process where suddenly it clicks in your head and you're like, OK, this is what I want to say, these are the key subtleties

> that I want to pick up on, and it does make you feel uncomfortable, but it's good and you feel very satisfied by the end result

For these two students, the purpose of the research, whether expressed in personal terms or in terms of a polished piece of written work, was what carried them forward. This goal-orientated disposition was also mentioned by Students C and K in articulating how they overcame uncomfortable but ultimately less significant challenges, so that, for Student K, 'it didn't ever get to the point where I was, like, I don't want to do this anymore – it was….a minor kind of challenge, towards a kind of major goal', and, for Student C, it was about changing his frame of mind by reminding himself of the excitement and privilege of doing the research in the first place:

> ….just taking a step back from it and saying actually there might be one small problem, but in the grand scheme of things this is an amazing project, the fact that you can do this kind of work while still a school student is a totally unique thing

Where students had experienced this excitement and adherence to an important goal, it appeared from some interviews that there came a feeling of personal responsibility, something intimately related to autonomy within an actual, real-world community of practice. Frequently, this responsibility was expressed in terms of the tasks themselves. Student L, for example, spoke about 'the responsibility to the work – that you need to do it – otherwise you feel that you've….not failed, but that you've just not succeeded as much as you could have possibly done'.

This kind of responsibility was very much in evidence in the research work I saw being conducted by one of the design groups. Because vital materials had not arrived, the group took the responsibility of completely re-organising the activity for the session, inviting one of its members to report on some in-depth research on silicon moulding he had

conducted, his findings challenged by other members of the group. The group chased up the order for the missing materials and items of equipment were also requested. None of this was done with the intervention of the teacher. It was, instead, a group of students immersing themselves fully in the 'culture of expert practice' (Collins et al., 1989: 488) and demonstrating the effects of both co-operative and challenging collaboration, the power of "context" and "contest" celebrated by Vygotsky (see Vygotsky, 1978: 86, 90).

A more developed sense of responsibility for the work was one of the characteristics that drew some students towards leadership roles. Sometimes this was as a result of simply taking on more work than other students and thus becoming a source of expert guidance because of what Teacher 5 informally described to me as the 'extra flying hours' of research they had undergone. At other times, it was more to do with finding oneself in a leadership role by circumstance and rising to the challenge of epochal transformation, as happened to both Student A and Student E:

> ….this has given me the opportunity, because without almost meaning to I've stepped into that role because I just had an interest in it and entered the group earlier this year and then because they've gone just had to step up into that role so it's almost kind of forced me into it, but I think it's a good thing because it's making me take on roles that I maybe wouldn't have been comfortable with (Student A)

> ….when I first came into the project and I was new, and I was just appointed the leader….I thought, what am I going to do? I don't know how to do this. But because….it's in at the deep end, you have no choice but just to get on with it, and so from then I think my leadership skills have just improved because I've got a lot more….direct and able to be just like, OK, here's what we need to get done (Student E)

Once in their leadership roles, both of these students appeared to develop a stronger responsibility, not just for the work, but for the people sharing the work with them, Student A feeling that newly recruited student researchers needed to 'feel that they're actually doing something in the project' from the start in order not to lose their interest and Student E feeling that she had to 'work harder than other people in the team' to prove herself worthy of their trust in her leadership and to put considerable effort into strategic and organisational aspects as '[she] did feel responsible slightly for them doing well'. These responses also illustrate powerfully how autonomous decision-making by students can result in the hard-won 'strategic' and 'tactical' metacognition observed in Krajcik et al.'s case study of PBL in one US school (Krajcik et al., 1998: 346).

This sense of leadership and personal responsibility, both to the work and to people, was not universal in the data, however. In my observation of the pairs of students involved in music research, for example, it was clear that some students had not succeeded in overcoming technical difficulties and relatively minor communication problems and had not planned for the absence of student research colleagues in making presentations, perhaps through over-reliance on the suggestions and interventions of teachers. It should be stated, however, that there was no evidence from this study to suggest a difference in the way students respond to transformational leadership possibilities based on subject alone; any differences observed seemed to be more to do with the structural and relational aspects of projects and the degree to which teacher-leaders of longer-running projects had refined their approaches.

5.3.3. Does autonomy work for all students involved in research-based learning at the case study school?

It is interesting to set this evidence – that not all students in the groups I observed seemed to be flourishing in the autonomous roles they had been encouraged to take – alongside

other evidence from the student and teacher interviews. The head of research posed the question of whether the school only developed students who already matched the school's philosophy, or whether it had 'the capacity to change their minds', in other words to enable a broad range of students to be transformed into successful, open learners when a significant number of them, whether internal or external, had not entered the sixth form with that propensity. She went on to describe the philosophy behind the school's attempt to do this:

> I think if there's someone with the intention there we should….be able to find a research project that suits them, actually, and….because it's building skills, I hope, as long as it doesn't go too far and he doesn't spend too much time on it, it's building skills that he can then transfer into his lessons, so, and building confidence, I mean, hugely important….and it can for either end of the spectrum (Teacher 5)

There are some key ideas here which it is worth testing against what students and teachers had to say and what I myself observed – that students and research projects can and should be well matched, that it is at least partly about building skills, that those skills need not be at odds with the work that goes on in conventional A Level lessons and that the whole process can build confidence for able and less able students in the context of the (selective) case study school.

Formalising the research programme at the case study school by pitching the different options to new Year 12s, encouraging them to complete a questionnaire and linking the research projects more explicitly to the Extended Project Qualification – all this inevitably shifted the emphasis away from research-based learning as an elite opportunity for a minority towards a more inclusive programme for the majority. This attempt at inclusivity could be seen in the growth of a broader range of projects (new ones springing up, for example, in English and geography), in the growing numbers

recruited for existing projects (for example, the MBP project in biology) and in attempts to emancipate students whose engagement had been limited in some way in the past. The head of physics, for example, saw the establishment of research projects as partly an opportunity to open up the exciting possibilities of her subject to students whose only experience of it had been dull and non-conducive to personal contribution and engagement, an experience to some extent gendered:

> ….students – you know, for example, especially girls, I think – I think they see the world of physics as….not very appealing….they don't feel they're sort of there as part of it, whereas actually when they get going and use data and contribute fundamental stuff about dark matter….then they feel that of course physics is for them and they can see themselves in it (Teacher 1)

At the same time, Teacher 1 identified as an 'underlying passion' that students in science should be afforded the same opportunities to 'have an opinion and to contribute' as students in the arts and humanities, where personal space for individual sense-making is more integrally built into the history and culture of the subject. Of course, this cuts both ways, the head of humanities (Teacher 7) making it quite clear to me in his interview that he was appointed partly to 'chase' the head of physics, since the science projects she had introduced had been so prestigious and impressive in their ground-breaking, real-world outcomes.

In terms of research projects building the confidence of students from a full range of ability, there was an interesting distinction made by the head of history in his interview with me. There was certainly, he remarked, a 'spectrum of ability' between and within the various history research groups, but there was also, and more importantly, 'a spectrum of responsiveness' (Teacher 3). This foregrounded the idea, that, whilst high-performing students undoubtedly made their mark through the research opportunities, at

least as important was how well students of all abilities engaged with the work initially and continued to be dedicated to it.

There were clear examples of this in the material from the interviews. Teacher 2 recounted a circumstance in which a student, despite struggling with his A Level work and 'not be[ing] an obvious choice for an academic', managed to speak at a symposium because his engagement with the MBP project in biology had been 'on the money from Day One':

> ….he was one who came up with ideas about how the project could progress and what it could do, so, you know….it does come from across the breadth, but, yes, you know, probably, you know, more….those who really get engaged with it

The second example came in part of my interview with the head of research in which she showed two very different paths to effective autonomy, that of a very able student who managed to speak eloquently to a group of visiting Australian head teachers who were 'blown away by her', despite her having worked for only one month on her project, and that of a student, struggling academically, whose passion for seismology led him to develop an authority and independence in his research area very much at odds with his academic performance in syllabus-led learning:

> …. he's got the seismograph working and he's got the computer programme, he's gone to speak to other members of staff about where he can put it, and, you know, he's really become independent, whereas when I'm giving him essay feedback, he can't write coherently….I said to him….I can't organise this for you – here are the tools, off you go; if you reach any roadblocks, let me know and I'll try and help, but….so from the very, very able to the less able, actually, it develops learners (Teacher 5)

These are powerful examples, but further interviews and my own observations of research groups at work provided me with evidence of rather different responses from some students who had struggled with the intellectual demands or the degree of autonomy that came with the territory of minimally scaffolded student research. In my observation of the history groups at work, for example, it was noticeable that there was significant variation in the autonomy, intrinsic motivation and sense of responsibility demonstrated in the dispositions of the students involved – one student had apparently given up on the whole research enterprise, some were beginning to adapt to the requirement to think and work independently and collaboratively and one student was already showing signs of working as an historian. Whilst the teacher had provided a clear opportunity for legitimate historical research and analysis, several of the students were finding it hard to switch from the situated learning of a school student to the situated learning of the peripheral insider, a certain disorientation being felt in what my field notes refer to as a 'learning lethargy'.

From the interview with the head of design, it appeared that this sense of disorientation and disengagement might result in avoidance strategies and overtly emotional reactions:

> ….some are really, really quiet, really, really quiet and you….you know, they don't turn up to your lessons, they try and shy away from you, they avoid you – you've got those who are incredibly emotional, and they will cry in front of you (Teacher 4)

These reactions, of passivity, disengagement, lethargy, absence and tearfulness, were perhaps part of the reason why certain teachers saw a natural divide between the high-performers and the rest in research activities. Teacher 2, initiator and leader of the MBP project in biology, spoke of the 'few, and they are a few, exceptional students who are really switched on', giving the example of one student who was at that time on a study

placement in the US, having gained a place at Oxbridge. He went on to say that the level of autonomy achieved by this student was unteachable – 'you can offer opportunities to students who are like that, and if they want to run with it, then they can' – but that, for the rest, it was a matter of becoming 'practically competent' and 'developing the characteristics and the skills associated with scientific research', admitting that they cannot be said to be in any sense 'research scientists'.

Whilst Teacher 2 appeared to suggest that this activity of what Teacher 5 called 'building skills' warranted the involvement of the non-exceptional students in the research, there were those who voiced the opinion that, for many of these individuals, involvement in research-based learning was a dangerous distraction. The former head of science at the school traced the development of the science projects and what he saw as its effect:

> No longer was it just the more able students who were carrying out the work, but it became all-inclusive and to be honest some of the students there would have been better served getting on with their school work (Teacher 6)

Agreeing with Teacher 6, Teacher 8, an experienced physics practitioner and advanced skills teacher, questioned the 'academic rigour' and 'work ethic' of many of the students he witnessed becoming involved in research projects. For these students, 'to ask them to go above and beyond [A Level study] I think is too demanding for many of them'. For him, as for Teacher 6, the problem had derived from the all-inclusive nature of the programme as it developed in the school, the attempt to 'implement it….across the board' when 'I don't think many of our students are capable of doing it'.

From the evidence explored here, and returning to the extract from my interview with the head of research with which I began this section, there is a clear ambiguity in terms of the extent to which autonomy has worked for all students. Despite the emancipatory drive to encourage all students to contribute actively in science and evidence of lower-

performing students finding confidence and growing their skills through strong participation in legitimate research, some students have clearly struggled with the demands of their autonomy, becoming disengaged and, in some cases, emotionally distraught as they cope with the 'grappling with uncertainty' that Hmelo-Silver finds so typical of PBL in her psychological meta-study (Hmelo-Silver, 2004: 257).

Part of this ambiguity may stem from the different ways in which research leaders see learners, and from the messages, conscious or unconscious, this sends to those students whose autonomy is challenging and hard-won. Where the approach derives from a view that ability is 'malleable' and 'incremental' rather than 'fixed', it might be argued that students will more readily find ways of achieving 'mastery' over time, whereas the idea that only the inherently very able can achieve and transform is in itself limiting (see Dweck, 2000: 2-3). Having said this, however, there was evidence that, even in learning environments such as those observed in history and design, with their open, democratic and positive approach, it was still the case that some students dropped out, drifted and succumbed to the pressure of their own autonomy.

5.4. Student motivation

Some of the ambiguities emerging from the data with regard to student autonomy were, unsurprisingly, reflected in what the interview responses had to say about motivation. Many of these responses related, explicitly or implicitly, to two broad types of motivation, *intrinsic* and *extrinsic*, motivation springing largely from within the person and that springing largely from without (see Ryan and Deci, 2000). Analytically, it is a useful distinction, especially as the students interviewed (and, indeed, the teachers) were engaging in research-based learning in a context where they were locked into an examination system that was extrinsically driven by syllabus and examination.

Students' voices in the interviews explored many times their enjoyment of 'the actual process of working on academic tasks' within what Brophy calls the 'cognitive socialization' of the liberal institution (Brophy, 1983: 211-213), but they also demonstrated awareness of the important but constraining forces of extrinsic influence. It may well be that long-term success for these students will be down to a 'perceived internal locus of causality', in other words an intrinsic orientation to learning (Grolnick and Ryan, 1987: 897), but the immediacy of what is required of them as young adults approaching the end of their schooling and preparing (mostly) to take up places at universities also emerged from the interviews.

This section of the study aims to compensate for the paucity of directly relevant evidence on student motivation in the literature (see Hmelo-Silver, 2004: 259) and offers three ways of looking at what is revealed in the interviews:

1. Extrinsic motivation: application for university, the curriculum vitae and cultural influences
2. Intrinsic motivation: 'fun', passion and cognitive drive
3. The balance between extrinsic and intrinsic motivation and discovering one through the other

5.4.1. Extrinsic motivation: UCAS, CVs and cultural influences

In his reflection on his leadership of the LUCID research in physics, Student C voiced his frustration at the limiting mind-set of some of the neophyte student researchers with whom he came into contact:

> ….one of the problems that you get sometimes is that people, having been through school for lots of years, expect to be taught, and they just say kind of, well, what do you want me to do? how do you want me to do it?

It is, perhaps, however, not surprising that many students arrived at the first research sessions of their chosen project with what we might call a motivation-deficit, and, indeed, the head teacher of the case study school himself acknowledged in his interview that, in the end, some students never progress beyond Student C's first stage of 'what do you want me to do?', continuing with the research simply for their UCAS or job applications ('some of the research the students are engaged with….they don't understand and they're just following and….getting it on their CV'). Teacher 8 concurred, adding that there were a number of students who would 'drop these projects like a stone' once the application process was over.

We might give this response to extrinsic influence the somewhat oxymoronic term *passive motivation*, although, as Student C implied, there are also clearly plenty of students who have eventually made the transition to independence of thought and action. However, there is another kind of extrinsic orientation which is less passive, where the student actively pursues a choice of research activity for specific, well-articulated, but still essentially extrinsic, reasons.

Student M, for example, whilst articulating very clearly his commitment to his research into dementia and chess, was open in his interview about his extrinsic motives for carrying out research at school, asserting that it would give him 'something to talk about in interviews or put in my personal statement', an extra achievement that would give him 'the high ground over other applicants to competitive courses at top unis.' Student J, a committed member of two projects in science, nevertheless showed a keen awareness of the advantages of carrying out research for very similar purposes to those of Student M:

> ….doing the research projects helps you stand out to universities; hopefully that will help me on my application – they'll see, OK, he's done extra-curricular, he's actually got a real interest in this topic and he's gone and researched further, so from an outsider's point of view looking on, hopefully they'll think more positively of me

Interestingly, this student described very different extrinsic motives for becoming involved in the two science projects (RAY, an offshoot of the LUCID cosmic ray project in physics, and MBP in biology):

> The main reason for getting involved in RAY really was my brother….for getting involved in MBP, one of the other research projects I've been involved in, though – that was because I have an interest in biochemistry, specifically proteins, which MBP is all about proteins….I also want to go and do medicine as a degree, so again it's all relevant with the biochemistry thing, and I'm just very interested in that side of science (Student J)

There are two quite separate extrinsic motives here – the direct influence of a family member (although Student J later went on to say that he soon became more intrinsically motivated in continuing with this research) and Brophy's academic motivation within the 'cognitive socialization' of a strong subject orientation (Brophy, 1983: 2013), though both of these have, of course, a very personal dimension that might also suggest a more intrinsic approach.

5.4.2. Intrinsic motivation: fun, passion and cognitive drive

Despite these clear statements about extrinsic motivation, however, the overwhelming evidence of the interviews suggested that students were much more likely to have adopted roles in research at the school for intrinsic, or mostly intrinsic, reasons. For some students, the intrinsic motivation began in childhood and had been sustained into

young adulthood. Thus, Student L revealed that science had 'just always been a big part of my life….it's just always been there', and the innovative design project of Student D began as a reflection of the enjoyment of complex Lego building in Year 7, the challenges of the more difficult sixth form work still resting on 'how much fun you're having when you're doing it'.

This very personal, long-standing affective drive to engage in projects was matched by what other students had to say about more reflective reasons for embarking on research-based learning. Student O revealed that her mother's chronic illness was part of her desire to proceed with the MBP project, even if her work might not have any direct impact on her mother's health:

> I was sort of thinking like I want to be useful, I want to find out stuff that's going to help people….in other words thinking that if I do something that might be helpful in….eventually developing a treatment for MS, or something – it probably won't affect my mum, but it might affect someone later down the line or something – I think that was a bit naïve, I don't know

The feeling of naivety expressed here masks, I think, a genuine desire to make a difference that springs from a deeply personal experience but is also mediated by a developing understanding, through the research process, of just how difficult it is to do this – the transformative urge chastened by the reproductive realities.

For Student P, the epochal transformation which led to his embarking on historical research into the local impact of the First World War came from a single moment, that in which he laid a wreath at the Menin Gate on behalf of the school. Always interested in history, he was clearly jolted into a sense of its power, pathos and significance in what he describes as a 'humbling moment'.

These deeply personal motivations, some springing from childhood, some from later and more reflective thinking, appeared frequently in the interviews, but equally frequent were the expressions of a love or passion for a particular subject coming from a more cognitive source, an incremental transformation that has built more slowly towards an independent learning disposition. Student K spoke about a love of chemistry and music and how these two areas of knowledge and expertise came together in his research project on singing and Parkinson's. He reflected on the generalised nature of A Level syllabuses and how much more personally motivated he felt about his own, very specific, focus:

> I'm learning about stuff that I really love….that I'm choosing to learn about, because I think some of the syllabuses for the A Levels….have to support a wide range of things, and my interests are quite kind of specific, so….I find it kind of a lot easier to learn it and….all the time I'd have papers in my bag about things that I care about

In a different subject area, English Literature, Student G expressed a very similar feeling. This is intrinsic motivation set against the extrinsic drive to do well in A Level examinations, but also aware of the extra effort and determination required to succeed in both, an effort and determination fuelled, as with Student D earlier, by sheer enjoyment:

> ….the main difference is in terms of self-motivation and actually feeding your interests because they're your interests, rather than because you have to get this grade at the end of the year that's actually just a letter on a page….if you're determined enough, and if you enjoy it enough, then you will learn to fit it all in

Another student, also involved in the *Frankenstein* project in English Literature, agreed with Student G that the research work she had been involved in took her away from a narrow, utilitarian idea of learning towards the conceptualisation that learning should be about intrinsic passion, even if it is helped on its way by the encouragement of a kind of commissioning process. Viewed this way, it also builds a soundly-based academic identity which can, according to this student, bolster the learner against the disappointments of more conventional syllabus-based learning when they occur:

> ….it was intrinsic because it….came from my passion, it came from me enjoying learning, enjoying what you're doing, rather than, "I've got to get the grades so I can go to university so I can get a job" – it's meant that I'm not placing all of my view of myself academically in my exam grades….that's a separate thing to who you are academically anyway (Student H)

This turning-upside-down of conventional ideas of academic identity was caught, also, by Student C in reflecting on the degree to which he was influenced by the need to impress a Russell Group university or by a sense of thinking in stages about his academic progress:

> I wouldn't say I was just doing this for the sake of having something impressive to talk about to get into university….I think of it as something which is great to do in and of itself and you should just kind of try and get as much enjoyment as you can out of everything at every stage….if anything, that will be defining, like an ultimate goal, as it were, in life, rather than the other way round

For this student, what was important was not how and whom to impress, not building cumulatively towards some academic zenith, but enjoying each moment of new research 'in and of itself' and allowing that to be a 'defining' future principle – the deepening and maximising of learning at each moment it occurs. This impressive example of meta-

learning exemplified, and perhaps even went beyond, the enduring, 'more thoughtful and robust' disposition to lifelong learning identified in one study as a significant effect of exposure to project work (Krajcik et al., 1998: 341).

Committing oneself wholly to new learning and defining oneself by it, rather than by examination performance and grades, appeared, however, more difficult to bring off for other students whose conventional learning at A Level had proved more seriously problematic than would appear to have been the case with Students G or H above. In his interview with me, the head of design voiced his concern about one (apparently not wholly untypical) student whose intrinsic enjoyment of her engineering project, whilst to be lauded and encouraged in itself, was perhaps occupying too much of her time and energy in a situation in which her planned future was under threat:

> I said to her, look, you're going to have to stop doing the engineering, because we need to get these grades up, but she said to me, but I'm getting more out of the engineering team than I am some of my subjects – my response was, great, fantastic, however….unfortunately, in the world we live in, if you don't get your ABB, even with the engineering experience, you won't enter the course (Teacher 4)

5.4.3. The balance between extrinsic and intrinsic motivation and discovering one through the other.

From the breadth of interview evidence, those who had flourished most successfully in their research projects appeared to fall into two categories:

- Very high-performing students who had thrown themselves fully into projects, riding the intrinsic love of their subject and valuing the opportunity to forge new

dispositions and roles as learners from this experience, and not from extrinsic factors or from examination preparation and performance.

- Students who had found a balance between the intrinsic and extrinsic motives for their project work, and between research and syllabus-led learning, and were comfortable with both.

Those students who fell into the second category tended to maintain the balance in rather different ways. There were those, for example, who saw themselves as basically intrinsically motivated, but with an awareness of the added benefits of their research work. Student P, whilst stressing his attraction to, and perseverance with, his history project because it is 'a subject I feel passionate about', nevertheless admitted 'there was a slight factor of UCAS', and Student E was strongly adamant that her design project was 'something that I would want to spend time doing' and that 'no amount of teacher telling me to do it' would have persuaded her to engage with it, whilst acknowledging at the same time that 'there is obviously the added benefit that it's good for uni applications'.

Then there were students for whom the extrinsic factors were so bound up in their intrinsic motives as to be indistinguishable from them. Student F explained lucidly that his choice of both A Levels and research-based project, leading to the EPQ award, came about entirely because of the desire to be engrossed in mathematics and to study it at university, and that the project enabled him to answer a burning question for which he needed to know the answer:

> I did the maths A Level and I'm doing the further maths A Level because I need it to get into university to study maths, but I do it to study maths, because I love maths….and….I want to do it for the rest of my life. I'm self-studying the statistics because I want to know as much statistics as I can as early as

> possible….I'm doing an EPQ because they tell you you have to but also because I really need to solve the question – which is correct [of two conflicting statistical methods]?

Student Q was similarly straightforward in seeing her motivation as a mixture of intrinsic enthusiasm, career-mindedness and personal advantage:

> ….for me I have an interest particularly in geography; it's what I'd like my career to be in, so for me it was something that, one, interested me and if I have a choice I would choose it, and, two, it's something that would help distinguish me from other applicants when I apply to university

Other students spoke about their intrinsic interest in their research subjects as existing against a strong background of extrinsic support within an emergent institutional culture. Student P, whilst acknowledging that 'I did know that it was good for a uni application', nevertheless singled out the school's enveloping culture as a more significant element in his decision to commit to the history project, 'that sort of ethos of the school….a constant encouragement just to get involved with things'. This evidenced the interview statement of the head of humanities, that 'a healthy handful are doing it because they're really interested in the subject….but they keep hearing quite a bit of extrinsic motivation from the members of staff, too' (Teacher 7).

Finally, there were students who spoke of a *process* by which intrinsic and extrinsic influences fed off one another. For Student A, part of the CERN-at-Sea group, there was a three-part process, initial intrinsic enthusiasm and curiosity giving way to procedural work, an extrinsic carrying out of tasks, which in turn transformed itself into a deeper, intrinsic absorption:

> I think to begin with it was very intrinsic, because I had an interest in that subject….and then once I got there and we started doing things it probably shifted more towards the extrinsic because they were saying, "Right we need to do this and this," and we were just getting on with it, and now I think it's shifting back more because, as I've spent time there, I've really got into it and it's shifted back to the intrinsic because I'm now interested in and want to do it (Student A)

It should be obvious from the above that no simple delineation of extrinsic and intrinsic motivation could do justice to the subtle and complex interactions of affective and cognitive influences that govern students' choice of research work, some from "fun" or passion, some from their own childhood or family, some from the 'cognitive socialization' (Brophy, 1983: 213) of absorption in tasks, some from career-minded determination, some from a worldly-wise understanding of the competitive realities of university application. In critical realist terms, when students persevered with their research work and made an impact, it was often a process of interweaving the reproductive with the transformative, each feeding off the other, in the emergence of new ways of seeing, *morphostasis* and *morphogenesis* co-existing rather than being structurally independent.

5.5. Relationships

The same kind of interaction between reproduction and transformation that emerged from my discussion of students' extrinsic and intrinsic motivation could be seen in the relationships students built with others during their research projects. In the interview data, these relationships fell broadly into three categories:

1. Those between students and teachers at the case study school

2. Those between students and individuals or organisations working outside the school (for example, experts in their field, companies, university research students)
3. Those between students and other students within the case study school

I have not included other relationships here, such as those related to family or friendship groups outside school, since these were referred to very rarely by students at interview. The order in which I have listed the three categories above relates to the number of coded references in the data, the most numerous first.

5.5.1. Relationships between students and teachers at the case study school

In his draft document setting out the pedagogy of the school, the head teacher refers to a desire to move away from the 'intellectual compliance, dependence and acceptance' of the conventional student-teacher relationship, towards the provision of 'experiences and opportunities for students whereby they undergo the life-changing experience to become people who increasingly learn autonomously', something which teachers can achieve by 'encouraging from a distance'.

In his interview with me, he fleshed this idea out a little more, speaking about an 'organic and evolutionary' process, inside and outside the classroom, such that students develop 'a different relationship with education and with their own learning', something which is reflected in the 'joyous' moments when teachers can celebrate being thoroughly challenged by students, needing to 'tease out' new approaches as they engage with them.

These comments refer, of course, to the range of learning that happens within the institution and not just research-based learning, but the emphasis they place on a non-hierarchical, open approach is particularly apposite in describing what happens in

student research projects, as was, to a large extent, confirmed by evidence from the interviews.

It is not surprising that the data showed teachers providing students embarking on their research with information, links and skills crucial to the successful completion of the research activities. However, most students attested to the fact that the necessity to 'lean on' the teacher (Student Q) did not persist, but rather transformed itself into the kind of 'encouraging from a distance' that the head teacher writes about, the whole process being very close to the idea of emancipation through a remodelling of the notion of apprenticeship (Wenger, 1999: 11). Thus, discourse beyond this initial period became a matter of 'conversations…. to kind of tease ideas out of you that you wouldn't have otherwise thought of' (Student G) and support fell back to a position in which students could call for help when they needed it, as Student Q revealed:

> I think initially, like the first month or so, we did rely on her teaching us – after that it was a lot more independent, but I think there was still that element of, are we on the right track, are we heading towards where we want to go?

This lighter-touch approach to students who had mastered the early stages of project work seemed to liberate students from the need to seek help with the minutiae of how to proceed. According to several students, teachers generally succeeded in creating space for them to explore and rise to the challenge of the research, achieving that 'sense of professionalism' (Student P) in which 'it's up to you to get help', even when that is simply 'reassurance that it's going in the right direction' (Student E).

Interestingly, even Teacher 8, who was elsewhere critical of the way research-based learning had developed in the school, was happy to acknowledge that supporting students in this way opened up different, and highly productive, roles and relationships

in which the teacher becomes, in Bruner's words, a 'guide to understanding, someone who helps you discover on your own' (Bruner, 1996: XII):

> ….it does change the relationship….you would be talking about things you wouldn't normally discuss in a lesson, and you are talking to them on a different level….I didn't feel as though I was the teacher any more, I was just sort of the facilitator making the suggestions, so when these guys were saying, you know, we're going to try this, this and this….yeah, you go with it, you're the experts on this….it gave them the opportunity to show skills that I would never have seen otherwise (Teacher 8)

Allowing space for students to work independently and transferring the onus to them to seek help during the development phase of projects was, however, only one way in which an unconventional student-teacher relationship manifested itself. From the interview data, there was also a strong sense of students working alongside teachers in a genuine community of practice as both parties handled new material and ways of working.

Thus, the lead teacher in geography research (Teacher 5) spoke of 'the barriers that get broken' between students and teachers as new knowledge and understandings emerged, something I observed myself in design as students and the lead teacher achieved an easy, relaxed relationship, with respect on both sides, a relationship built on discourse emanating from online and physical research activity and from the exchange of creative ideas and problem-solving. When sustained, this mutuality was clearly an example of school operating as 'an exercise in consciousness raising about the possibilities of communal mental activity' (Bruner, 1996: XV).

Students confirmed that this was the predominant relationship in some of their interview responses. Student A spoke about being 'on a level' with teachers as both worked on

what Teacher 1 called ‘fathoming’ new material in science, a process where, as another student put it, teachers ‘almost join in with the students on doing research’ (Student G). This sense of an ‘equal relationship’ (Student H) between students and teachers, of a mutuality that nevertheless accepts and respects the greater experience of the teacher, was summed up by this student, speaking about her work in history:

> ….in terms of research-based learning, it was more we could just have a discussion about something, it was less teacher-student, it was more a researcher that knows more and a researcher that’s just starting out – it wasn’t as….the normal dynamic of a teacher and student (Student I)

Student Q, speaking about her relationship with the lead teacher in geography, also referred to students being seen ‘as our own researchers in our own right’, but, in my observation of the geographical research groups in action, I noted that, whereas the teacher constantly used the word ‘we’ in discussing the way forward for the pollen research, the decision-making around the following week’s activity came almost entirely from the teacher, something which was accepted without discussion. This “slipping back” into a more conventional, teacherly mode was observed, also, in the lengthy lecture at the start of the observed biology research session and the temptation to intervene with weaker students in history.

Whether occasionally flawed or not, it appeared from the interviews that this relationship of mutual exploration could sometimes become more personal. Student O revealed that there was a ‘slightly social’ element, both in terms of why she was drawn to her polymer research in the first place and in terms of how the relationship with the teacher and fellow student researchers developed. This social element was sometimes reflected in modes of address, as when, according to Teacher 1, students became used to using her first name

during collaborative research work, something which did not occur in her A Level classroom. Occasionally, this intensely personal quality in the relationship became slightly uncomfortable, especially when it disturbed accepted norms of behaviour, as Teacher 4 frankly revealed:

> ….I almost felt that I was….more one of them, rather than they were one of me – we were a little bit more chummy, you know, we built up probably a rapport which in the past I would never….there was a certain line that I would never….and I probably did with them – nothing dodgy or anything, very professional, but I normally don't get that close to individuals

5.5.2. Relationships between students and individuals or organisations working outside the school

The informality in relationships between students and teachers in research mode was seen by several students as reflected, also, in the relationships developed between students and individuals or organisations working outside the school. Student J, for example, saw his 'working relationship' with both teachers and outsiders as 'informal' but 'polite'. For Students A and C, this polite informality derived from the environment in which both student and outsider were at work. Student A, working on the ground-breaking CERN-at-Sea project, found herself discussing software applications with experts in the field, but was 'treated as an equal' for the very reason that 'it was a high-flying environment, and….they saw me as someone from within that environment'.

Similarly, Student C rose to the challenge of speaking at scientific conferences, having gone there 'as a delegate, as any of the researchers would do', and ended by working, quite routinely, with experts from the space industry. In the tone of his description of

working with a NASA team leader, there was not even a remote suggestion that this relationship was anything other than a workmanlike collaboration between equals:

> ….we've been working a little bit actually with a man called Larry Pinsky, who's from NASA and he's heading the symmetry team for all of the space stations, but, especially the main thing now is the astronauts on board the international space station, trying to measure what kind of dose they'd be getting at the time and whether or not, working with biologists, well, doctors, I suppose, whether that would be dangerous to them over the long term

For some students, the nature of the academic community into which they had been launched was a surprise. Student O revealed that the social networking side of scientific work was revelatory: 'going to conferences and just meeting people, and then getting into contact with people….I hadn't really thought about that before.' As with the relationships with teachers, this social aspect sometimes took the form of quasi-friendships. Student N recounted the easy, sympathetic relationships developed between her polymer research team and doctoral students from the local university:

> from the first we made a bond with them, we were friends, we were like emails and things like that, and they talked about it easily and purposely made us not be scared of it – I think they made an effort not to make it seem scary

The doctoral students, she reflected, created calmness in their relationship, such that mistakes were treated sympathetically, and there was a sense of collaborative interaction between the university and the school research groups. However, there was also evidence, from the same interview with Student N, that this relationship was actually rather more complex, in the sense that the doctoral students seemed to have adopted, consciously or unconsciously, teacherly roles, trialling the students to see who was

suited to which procedure, using helpful analogies to help the school students understand advanced ideas and techniques and delaying explanations about the mathematical underpinning of the chemistry involved until the students were ready to absorb them:

> ….they told us the maths behind making it, all the different ratios and things that we needed; if they'd showed us that at first, I think we'd have been a bit [uncomfortable], but we've had a year of learning about it, so now we could understand it

Perspective is all, of course, in these relationships, and it is worth recording the reflections of another student involved in the same polymer project. For Student O, the focus of the research had been, and continued to be, definitely on work at the school, contact with the doctoral students being amicable but minimal:

> we don't have masses of contact with them – they've been into school once, for a meeting where they told us more about what the data we'd be producing would be used for, and then we went up to the university once and they sort of met with us there….I guess I don't feel like I have a personal relationship with them at all – they're up in the university, we do the research here

What emerged from this data was an ambiguity in these relationships between school students and outsiders from academia and industry. Whilst there was a sense in which some students appeared to achieve a kind of parity with more experienced experts or established industry leaders in their field, largely through being in the same environment and sharing the same drive for knowledge and understanding, there was also a feeling that some friendships which grew out of these working relationships were somewhat ersatz and built on the desire to initiate and sustain collaboration, partly through behaving as a teacher would behave.

This ambiguity emerged from interviews with a range of other students. Some students spoke, for example, of feeling that they had to prove that their work was of 'the same standard as professional work would be' (Student E), rather than be accepted automatically as fellow researchers by a design company, or of coming up against 'funny looks' (Student C) when preparing to speak at a science conference as a student researcher. Yet, the trial-by-fire of these testing experiences seemed to be matched by a reciprocal, transformational growth in confidence in some students, feelings of awe and inadequacy turning to self-assurance as these 'nonmembers' (Wenger, 1999: 11) were ultimately accepted into external professional environments, Student E, for example, moving from being 'scared and daunted' in approaching high-powered company executives to feeling 'I'm a lot more calm and I know really that….now I'm capable of doing it'.

In her reflection on her work with the CERN-at-Sea project, Student A neatly summed up the ambiguity of these student-outsider relationships, with their mixture of disabling deference, reciprocal respect and mutual advantage, as she recounted conversations she had had with company representatives at a research conference:

> ….they've got that knowledge, you are learning from that knowledge and you are reliant on that knowledge, and when you're talking to people completely externally….like at this [conference lecture], I had people coming up to me that I didn't have a clue who they were and they were from companies who were interested in our work; there was a bit more of an equalness there again, though it was still daunting, but it was an equalness because….they knew no more about it than I did….but then also they were a lot higher up than me and they had the ability to sort of help us financially

5.5.3. Relationships between students and other students at the case study school

Though they did not always form and sustain themselves as smoothly as they might have, there seemed to be much less ambiguity in the relationships between students from the case study school and other students from the same school, as evidence from observations and interviews showed.

Students referred frequently to the fact that they approached and were influenced by one another in joining projects and in problem-solving during the investigative or experimental stages of their activities. Student L, for example, spoke about encountering difficulties in developing the computer programming for the LUCID project in physics and turning to friends who had experience in this area, rather than teachers, because 'it just sort of felt natural, that they would be the ones to know because they'd done it before – I didn't really think to go to a teacher to start with'. Similarly, in the detailed analysis of pollen carried out as part of his work in one of the geography projects, Student B referred to having trust in a fellow student researcher in asking for their opinion about the nature of a particular pollen fragment without asking the lead teacher ('….you've kind of got the confidence that they have a good idea of what it would look like').

This trust between students came across powerfully in the data. Sometimes, it was a question of a reliance born of procedural necessity, as when Student N spoke about working with a partner in dealing with polymer samples ('if you don't work in a pair you can't do it, so you rely on each other'). At other times, it was more about recognising the different skill sets within a collaborative research group and being prepared to offer and accept different interpretations of raw data, as in the examination of pollen particles in geography:

> we act out different things….like in the sources, one of us will pick out something and another person might read the same source and might see

> something else….and another member might have a different way of looking at something, sort of a read-between-the-lines sort of thing (Student Q)

This easy, flexible collaboration was referred to by other students as ‘drawing in expertise’ for ‘one kind of common goal’, even when ‘people are totally new to it’ (Student C), and as ‘bouncing ideas off each other’ in a situation where there were no given criteria for correct answers (Student J).

From this collaborative energy, largely unmediated by teachers, a resilient sense of group identity had formed itself in several projects. The lead teacher of both geography projects saw it as a ‘camaraderie’ which produced an atmosphere that was ‘real, intense but relaxed’, one of the teams in her research area even going so far as to identify with a particular name, ‘the pollenists’. In design, the trust students had built in their research groups was clearly strong enough to withstand the lively discussion I witnessed in one session where students challenged one another over production methods, and one student spoke of how, when things did not develop as planned, there was no blame attached to individuals:

> ….we actually worked quite well as a team; I never felt like I was going to be blamed for it going wrong, really, because….if I would work hard at something, they’d be grateful for that, and so if we got bad feedback they would never be quick to blame me because they’d be like, OK….we’re grateful enough that you’ve done it, now let’s work together to sort it out

This camaraderie that developed, seemingly organically, from student-student interaction appeared to establish itself, although in different ways, both in environments that were pre-structured by teachers and/or outside agencies and in environments that had formed spontaneously from the interactions themselves and in the context of the

research work being carried out. At its best, this spontaneity transformed, rather than merely reproduced, the existing culture of the relevant community of practice.

In the MBP work on multiple sclerosis in biology, for example, the established structure was tightly organised in a kind of triple-layered apprenticeship: lead teachers learning from university researchers before going on to guide the appointed Year 13 lead students, who in turn guided the Year 12 students in the laboratory activities, with different degrees of legitimate peripheral participation (Lave and Wenger, 1991: 115). Yet, despite this, there was evidence from my observation of the student researchers at work that students found space, not merely to reproduce the structure they had been given, but to transform it. They chose, for example, to continue with urgent laboratory work whilst the teacher was attempting to speak to the whole group and split themselves off from their designated sub-group to enter a discussion with the most experienced of the Year 13 students about cutting-edge biological technology, research structures, types of research paper and on-line, free-access, peer-reviewed research.

However, the transformative quality of relationships in groups that had formed and structured themselves more autonomously and organically was undoubtedly more noticeable. In one of the two design groups, Year 12 students, selected by older, more experienced design researchers through interview, pooled their specialist expertise in design, art, science and computing in the service of a newly researched and designed product, using Facebook as an added communication tool. Meanwhile, in the other group, students worked in different competitive sub-groups, one carrying out pure research into the technology, another deconstructing the physical workings of an existing prototype robotic vehicle and yet another looking into CAD/CAM production techniques.

The above evidence gives the impression that all relationships between students undertaking research at the case study school were positive and productive, and this remains so when considering only what students said in interview. However, the observations I carried out of groups at work occasionally presented a different picture.

In a series of music research presentations, for example, it was noticeable that, whilst there was thoughtful and productive discourse, this was almost all between students and teachers, not between students themselves – an earlier attempt to carry out and record dialogues to promote and share independent student learning had not been sustained owing to pressures of time and syllabus work, and so students working in pairs or groups were often isolated in these presentations and important logistical difficulties had not been dealt with. In my observation of the history research groups, there was wide variation in the effectiveness of student interactions. In one group, whilst two students talked animatedly about external sources and choices of end product, the other three students in the group dropped in and out of the discussion and contributed little. When the two more animated students explored with me the possibility of finding diaries and poems as primary sources, I suggested they consult a former teacher at the school, now a university lecturer, who had already worked with them; it was telling that the immediate response of this group was to do this through the teacher and not by themselves, to reproduce the existing hierarchical relationship rather than forge a new, transformative one.

From the data considered so far in this section, the freely collaborative relationships between students engaging with research at more-or-less the same level and with the same amount of experience would appear to be mostly positive. However, many students experienced a different kind of relationship with other students, one in which there was

a difference in level, experience or authority between them. From the observations and interviews, this difference occurred for two main reasons:

- Some students had been placed in leadership, teacher-like or mentoring roles by virtue of a pre-established scheme or because they were an academic year (or occasionally more) older than the students they were guiding, or
- Some students had achieved more of what Teacher 5 calls research 'flying hours' and so became mentors to students of the same age in a less structured way.

The evidence appeared to show that students were just as relaxed and positive about relationships where there was this kind of imbalance as they were about more directly peer-to-peer relationships. Student J, speaking about joining the RAY project in science as a GCSE student, described finding the natural assumption of a teacherly role by students older than himself wholly acceptable, since, in order to contribute to the project, he needed to know the basic physics of radiation, which he had not covered at GCSE. He went on to say, however, that the relationship changed once he had the knowledge required:

> ….they assumed sort of a teaching role, telling you the basics, but after that it was really….you were working with them – they were the main ones doing the research and you were just sort of with them….they were basically mentoring you as to what you needed to be doing

The relationship also appeared quite comfortable for most of those students acting as project leaders or older mentors. Student D spoke authoritatively about the relaxed, differentiated methods he employed as an appointed mentor for a student team participating in a global science and engineering competition:

> I would be there every break time normally, just making sure that they're OK….say if they'd been stuck on something for two days, you might say, "hang on a second….if you changed this in the programme, you might be able to get something"….not actually fix it for them but point them in the right direction; it's what I found to be the most effective way

For one student, reflecting on how she worked with an older student in a position of authority when she first joined the MBP project in biology, the relationship was hard to describe, yet amenable and effective, the phrase she finally found for the relationship being memorably precise:

> ….they're sort of instructing you, but then also you want to be friends and in the sixth form it's nice to be friends socially, but then also they're taking a bit more of a teacher role, so it's all a bit odd….like sort of a tutory thing….it was like he was a really knowledgeable friend (Student O)

In terms of students with more 'flying hours' of research acting as mentors for students of the same age and level of research, the process seemed to be even easier and more informal. Students in geography who had put in more research time than others were the source of information and expertise for those with less experience, but in no sense were they thought of as appointed into a role, and my observation of the work here suggested a very fluid process of informal mentoring, rather as in the case of Student K, whose help for a fellow student interested in music and mental health was all about suggesting reading sources and sending him links to websites, rather than any formal mentoring relationship.

From the above, it appears that students, when working at their most co-operative, determined and independent, achieved what Archer calls a 'creative re-design' of aspects of their projects (Archer, 2000: 308) in which they moved beyond merely reproducing material given to them by teachers or outsiders towards a modest transformation of both the subject of their work and, more broadly, the conventional pedagogical structures by which most schools have operated in the past.

In almost all projects there was evidence of relationships through which students reproduced practice successfully and achieved 'a stake in its development', moving on to 'situated negotiation and renegotiation of meaning' within the local enactment of that practice (Lave and Wenger, 1991: 115, 51 -52). Some of the relationships that had developed, for example in geography and biology, between students and teachers or outsiders and between students and other students, had, at their best, facilitated this process, despite occasional moments where teachers returned to long-established patterns of delivery and decision-making. Where, eventually, students were liberated to explore their trust in one another and forge a path forward independently, teaching itself became only 'one of [the school learning environment's] many structuring resources' (Wenger, 1999: 267), students relying just as much on the 'distributed expertise' (Hmelo-Silver, 2004: 246) of peers, as Student Q revealed above.

For teachers, successful relationships within these research-based projects seemed to be about a change from thinking about 'knowledge transmission', as they might do in delivering syllabus-based learning at A level, to thinking about how to enable students to carry out 'knowledge transformation' through relationships with outsiders and other students, however prone to initial difficulties these might be (Blumenfeld et al., 1991: 381), and to allowing students to identify and untie complex knots in their learning, becoming 'problem finders' as well as problem solvers (Gallagher et al., 1995: 139).

Clearly, however, the data has uncovered, in music and history in particular, incidences where the liberation of students from passive reliance on teachers has not been fully successful. The reasons for this are complex and rooted in the minutiae of the projects themselves, but the unsatisfactory initial choice of research area by some students and the well-intentioned over-supportiveness of teachers could be seen as playing their part.

5.6. Research-based learning in the context of the school's learning culture

The relationships discussed in the previous section were fostered, of course, in a particular learning culture at the case study school. Students themselves had perceptive things to say about this culture, and it is the purpose of this section to present and discuss the data from documentation and observations and, particularly, from interviews with students and teachers which elaborated upon it.

The presentation and discussion here has been divided into four sub-sections, based on distinctive emergent elements of the data:

1. The case study school's curriculum: what documentation and interview data revealed about the philosophy and policy of the school in terms of its learning culture
2. The broader culture: what the student interview data had to say about the culture of the school as a whole
3. Research-based learning: how the student research projects were contextualised within the broader culture of the school, and
4. How differences between the learning culture of the case study school and the learning cultures of other schools were illuminated by the data.

5.6.1. The case study school's curriculum: what documentation and interview data revealed about the philosophy and policy of the school in terms of its learning culture

From an examination of relevant documentation and from my interview with the head teacher of the case study school, there appeared to be three key aspects in the establishment of a particular kind of learning culture in the school.

The first reflected the way in which the school had attempted to break free from the traditional expectations of a state school curriculum in establishing its own distinctive curriculum, one which had recognised that 'whilst examinations and the intellectual skills required for success are necessary, they are no longer sufficient' and that 'we should not be teaching to the test' as 'slaves to the syllabuses we are teaching'. This is not a new observation, of course, and it is striking just how similar it is to the assertion made by Holec well over thirty years earlier that state education exists to its detriment in a 'general environment of dependence and passivity' (Holec, 1981: 34).

Instead, the school has proposed, and attempted to implement, a curriculum in which intellectual challenge resides in the promotion of a wider set of real-world attributes and so-called soft, transferable skills, such as 'communication, leadership, fortitude, teamwork, collaboration, responsiveness, creativity', and in the provision of a programme of broad cultural education in the arts and sciences. This is akin to the 'learning curriculum' proposed by Lave and Wenger, in contrast to an inert 'teaching curriculum', with teachers who act as 'didactic caretakers' (Lave and Wenger, 1991: 97, 112).

The second aspect was that the challenge to students should be one which cuts through the traditional expectations of what students can achieve at particular ages, expectations

based on the idea that pupils cannot truly become students until they reach university. The head teacher explains this as follows:

> ….it is comfortable and unchallenging to make the assumption that the movement from pupil to student requires certain levels of emotional and intellectual maturity on the part of the learner. Such a view, of course, reinforces the dominance of the teacher over the pupil, it reiterates the necessity of the traditional hierarchy between pupil and teacher in schools and so removes the potential 'threat' of the intelligent youth challenging a teacher

The third aspect pertained to the interaction between the student and her learning – learning to learn in different ways, through exposure to challenging research tasks and intellectual ideas. Thus, as the head teacher put it in his interview with me, 'it's not just letting them know something different from the syllabus, it's actually them engaging with learning in a different way'. Again, this takes us back to some of the ideas of the 1980s, Robert Glaser in 1984 calling for 'a new relationship between students and their subject-matter' through which 'knowledge and skill become objects of interrogation, inquiry and extrapolation' (Glaser, 1984: 103).

There was certainly some support for the success of this curriculum from the students themselves. Student Q, for example, reflected on the breadth of her experience at the school like this:

> I guess it's made me, I want to say, a different learner in some respects. I guess it's opened up different ways of how you can learn to me, it's not just always the normal way, listening to the teacher reading a text book, it's finding stuff out for yourself, challenging it and working with a team of people my age

Student H placed the emphasis firmly on the primacy of the challenge and desire to learn that the school had provided, and not on the chasing of top grades: 'more the idea that it should come naturally, because if you've got that interest and if you're inspired by it, and if you're going above and beyond the course anyway, then the good results should come along with that'.

Nevertheless, there was also some evidence that students remained in no doubt about the importance within the school culture of good grades at A Level. In contradistinction to her comments about learning, Student Q spoke about her disappointment that the school's underlying ethos was still 'aimed at grades' despite the assertion that the school's offer was 'all about extra-curriculum and learning off of the curriculum'. Student N concurred to an extent, seeing a 'conflict' between what the school stated were its overall objectives in terms of learning and the drive for examination success, but agreed that this double-edged quality was actually 'realistic' in that 'you can't dodge' the examination system.

In terms of the second aspect of the school's curriculum identified above, the challenge to the orthodoxy of age rather than stage, it was also interesting that, whilst age-related hierarchies were to some extent dissolved in the student research project work, they had an occasional habit of reasserting themselves, as when, according to Student M, younger students were discouraged from engaging fully and meaningfully in the plant science project (GROW) because they were in Year 11 ('I remember some people working on the Project GROW and they were literally just potting plants, completely away from all the science side of it'). Similarly, when I observed the MBP project groups in biology, despite the transformations some students were able to make to their ways of working, semi-impermeable hierarchies established themselves in the structuring of the research teams.

5.6.2. The broader culture: what the student interview data has to say about the culture of the school as a whole

The statements of intent from the head teacher in terms of the curriculum have undoubtedly been one very powerful influence on the broad learning culture of the school. They could be seen as both reproductive and transformative, however, as affirming and strengthening an existing culture and as setting expectations for both students and teachers which act to change it. Similarly, students themselves could be seen as being drawn to, and affected by, the existing culture, perhaps particularly those who arrived in the sixth form from other schools, whilst at the same time being agents in the change and expansion of that culture.

Students varied a little in how they saw the school's creation of a particular ethos and atmosphere for learning. Student P, a member of the school from Year 7 onwards, referred to 'that slight encouragement….just to go and research a bit more' which had been there from the start of his school career, whilst Student R, a new arrival in Year 12, went further, conceptualising the learning culture as 'a bit of an expectation' of students in which the gentle pressure to go beyond what was taught in conventional lessons carried through to the student research work ('….with A Levels in general it's not about what you do just in lessons, you have to do a lot yourself as well, so obviously that goes on to the project').

For Student H, this gentle pressure was reflected in the expectation that students should have their own opinions, teachers sometimes modelling contested discourse for students in their lessons:

> ….you can see the teachers all have their own opinions and their own beliefs, so it in turn encourages you to form your own and then challenge theirs as

> well….that's something that I think is unique to this school – it's that they place a lot of emphasis on the opinions of the students….it feels like your opinion is worth something

The expectations placed on both students and teachers, however, had, according to the head of humanities, led to a 'schizophrenic' culture which had 'several members of staff and lots of students on board and many, many, many, many that are not'. Whilst describing himself as 'an idealist about this experiment called….research-based learning', he nevertheless expressed sympathy for colleagues and students who had experienced 'a bifurcation in the school in the sort of the have-research and the have-not-research' which 'does create certain anxieties' (Teacher 7).

The data suggested that a related bifurcation had occurred in the school between those who had coped with its competitive environment and those who had struggled to do so. Student E suggested that for those students who were 'not at the very top' it could be 'quite depressing – not depressing, but….tough'. Student P agreed, but suggested that the school had also treated students as adults, asking them to 'look at [their] situation', and offered 'measures in place to actually help [them] do that'.

Student I traced this culture to the head teacher himself. She spoke of attending a UCAS reference interview and being shocked by the harshness of his approach, something she linked to the challenging expectations set down for students more generally:

> people here, it's always….you know, you don't always get a pat on the back, it's always, you know, you could do better and that's the culture of this school, it's to really push their students hard

She went on to question whether the approach was the right one to take in Year 12, especially for newcomers, as her 'confidence took a knock last year a lot, and to bring it back this year was quite a struggle', though she acknowledged that she was 'doing well now'.

The discomfiture identified or experienced by these students, however, is very much in keeping with observations in studies on authentic learning and emergent pedagogy. Some of the most effective practice discussed in Lombardi's meta-study of authentic learning came from environments in which students were confronted with 'uncertainty, ambiguity and conflicting perspectives' to develop 'more mature models' of real-world learning (Lombardi, 2007: 326), and Osberg and Biesta, in their constructivist piece on emergent pedagogy, write positively about environments deliberately designed to 'unsettle the doings and understandings of those being educated' in order to enable genuinely autonomous and creative learning to continue to happen, even if it is 'difficult and provocative and often uncomfortable' (Osberg and Biesta, 2008: 326).

On a much less equivocal note, all students who expressed an opinion about the school's learning environment were positive about the culture that existed in the student body itself, whether they were new to the school or not. Thus, Student C spoke about the 'way that people exist generally around the school', which defined them as a member of the school community, and the fact that this was not confined to the project work. Student G spoke about walking into any room at the school and hearing conversations about politics, the EU, a novel they've just read, or 'whether or not they love T.S. Eliot', though she was puzzled by 'where that culture emerges from'. Student H provided one answer to that question; for her, it was an 'atmosphere' which was created, first and foremost, by students themselves, and upon which the school had built:

> ….people are genuinely passionate about what they're doing….and people are aiming very highly….so there is a sense of a genuine interest, which I think then generates the conversation, which is really good, and then obviously the school plays on that

The emergence of the learning culture of the case study school comes across, in the end, as the result of the interaction between the self-generated culture of student passion and enthusiasm and the impact of the school's philosophy and policy in sustaining and developing that culture. Student P, invited to reflect on the meaning of culture and its local effect in terms of the school's learning, showed a clear understanding of how culture could be both reproduced and transformed at one and the same time from a critical realist perspective (though he did not use this terminology):

> obviously there are groups of people that identify to a culture, but they themselves are collaborating in a sense to that culture – I mean everyone's got their own idea of what it means to be British, for example, but then that's still accumulating to a sense of British culture as a whole, but, in the sense of a culture of learning at the [case study school]….we're always encouraged to do more….but it's not like we're forced to actually go and do more – it's like the door's just left ajar, in a sense, and then….you know you can open the door yourself, or not

The idea of the 'door left ajar' here seems to crystallise the school's offer to students as a route towards the transformation of its culture of learning, yet it does not, perhaps, take full cognisance of the pressures some students feel as encouragement sometimes appears to take the form of hard expectation.

5.6.3. Research-based learning: how the student research projects are contextualised within the broader culture of the school

Thus far, this section has considered culture as both a given social structure influencing those who subscribe to it and an emerging, transforming environment that has its own self-generated energy. However, culture can also be taken to imply a *process* of growing, of deliberate nurture, and the data provided rich evidence that students were able to reflect thoughtfully on how they had been, consciously or unconsciously, prepared for the demands of this form of learning in the sixth form and beyond.

This process of preparation seems to take three forms:

- The response of younger or less experienced students to a background noise of research in the school
- The ways in which older students had acted as mentors for younger students
- The projects specifically designed by the school to enable younger students to gain a foothold in research-based learning.

Student C referred to being unknowingly influenced, when a younger student, by the events happening in the school, such as public observing using the space telescope, the launch of the Star Centre (where most of the physics projects were established) and high-profile visits from, for example, an astronaut. Student K put this kind of influence succinctly:

> ….it's a very kind of research-orientated school, and I think just the fact that there are always so many projects going on, like when I was growing up I grew up alongside LUCID, and all the other projects, all the MBP, the….just kind of being in that environment where there is research going on everywhere

Allied to this buzz of activity was the specific tradition of older students mentoring keen but inexperienced younger researchers just starting out on their research journey.

Student C added to his comments on the background atmosphere created by events by referring directly to this traditional role:

> ….part of the role of the older students isn't just to do the work but to encourage people, even from a younger age….and just to kind of show them what it's about and get them into it

This seemed, from the evidence of both the student and the teacher interviews, to be a particular feature of the science and design research projects; indeed, in the MBP project in biology, it was built into the somewhat hierarchical triple apprenticeship model through which the research was carried out. Where it happened in English and the humanities, the relationships appeared to be rather more informal and to exist between students closer in age to one another.

Although they misremembered some of the details of the preparatory projects in Key Stage Three, the students who referred to them were unequivocally positive about them, at least from the perspective of more experienced sixth-form researchers. Student D remembered the two individual projects carried out in Years 7 and 8 as 'a good bit of research done there', beginning with the humanities project on communities, which 'kind of told you how to go about producing a project', and moving on to a free choice of science project in Year 8. Student P also referred to these projects, but remembered two other projects, in history (the Memorials Project) and design (the Architecture Project), which now had a greater, emergent, significance from that which they seemed to have at the time:

> I mean there was the idea of enjoyment, but there was that slight little hint of professionalism, really….but, to Year 8s, it's not really going to be a

> professional type of thing, but in hindsight you sort of think, yeah, actually that was, you know

In his reflections, Student P went on to elucidate the subtle effect of these projects ('I think we were just gently introduced to it without us knowing really….we didn't really know why we were doing it, but we knew it was going to probably help us at some point down the line') and Student R agreed ('I think they're trying to get us close to that period of being able to do what you can do….').

Teacher 1 (the head of physics at the time of interview) introduced a less positive note in her discussion of this wider process of growing the culture of research. A highly experienced leader of research, indeed one of the founders of the whole student research programme at the school, she spoke of the recent tendency for students who had grown up with the school's subtle development of student research skills to see the culture as normalised, and therefore of less especial interest:

> I wonder if it's become such the norm here that people just take it for granted….to a certain extent I worry about even having big speakers here, because people think that's just standard, and they don't necessarily turn up….I think it's just what the [case study school] does, and there's all these opportunities for research, but, you know, that's just how it is

This is, perhaps, a bi-product of the ease with which students who had experienced the learning culture of the school from Year 7 had approached research opportunities in the sixth form, but there was no evidence from the student interviews that this effect was active, either in terms of their own individual experience or in terms of the wider experience of all students. As was acknowledged by Teacher 1, the effect may well be

more to do with the increased choice now facing students at the beginning of Year 12, an expansion of opportunities which came from two developments in the school:

- The fact that more departments were "getting in on the act", stimulated by the success of the science projects and encouraged by the leadership team, and
- The appointment of a head of research in September 2015 whose remit was to broaden, rationalise and evaluate research-based learning in the school

Two examples of subject departments being encouraged to introduce research projects into their offer came from history and design. In history, a well-established project looking at the local effects of the First World War became a part of the menu of choice for a wider group of students. What began as a project whose purpose was 'knowledge for knowledge's sake' (Teacher 3) became one which was more tightly structured. Teacher 3's reaction to this change was mixed – clearly he felt that he 'already had a way of doing things and then it suddenly changed', which took away some of his autonomy, yet he acknowledged that 'this is the best model that I've run over the last few years'.

In design, a wholly new project programme was begun, based on an attempt to match the success of the sciences:

> ….it was basically the Star Centre, the work that they do there….there was a lot of talk about those projects, and I was thinking to myself there's no reason we can't do something similar to that, so – and that's why we decided to bring in the extra projects outside of lesson time (Teacher 4)

As revealed elsewhere in this study, these design projects have themselves been very successful and perhaps represent the closest match of any projects in the school to the situated learning model, with real commercial products being designed and

manufactured in prototype by students. The head of design also acknowledged that the programme had changed their way of approaching the learning in design, moving from 'very conceptual, very arty and very traditional' approaches to those with more product-orientated 'rigour' (Teacher 4).

The appointment of a head of research appeared to have rationalised changes already happening, developing them further and providing a structure by which research-based learning could be more obviously inclusive. The appointee described in interview the delicate balancing act required in, paradoxically, providing a tighter organisational structure in order to encourage a wider freedom amongst students more generally with regard to research engagement:

> I think research has the potential to be inclusive….I think if you're genuinely pushing the envelope, then, you know, that's going to be difficult….if there's someone with the intention there we should….be able to find a research project that suits them, actually, and….it's building skills that he can then transfer into his lessons and building confidence….and it can for either end of the spectrum….I think what we're driving at is that 'being the best we can be'….it's getting that balance between making it accessible to all, so it's a little bit normalised and expected, without it becoming a drudgery and something that they have to do (Teacher 5)

As she went on to state, it was all about having a 'wide variety of research products' on offer without taking away from the transformative autonomy of either students or teachers. An inevitable consequence of this widening process, though, seemed to be the very normalisation that the head of physics pointed to, in addition to the slightly competitive edge it brought to the recruitment of students at the introductory research fair at the beginning of Year 12, as Teacher 3 asserted ('it can become more competitive

than I think it maybe should be…. it's a strange, strange thing that's more of an accidental bi-product, I think, of the formal process that this year's brought with it').

Naturally, with widening access came the consequence that more students joined projects than would have considered joining in the past, and, for some of these, involvement brought disorientation and struggle, though there were, of course, many success stories, as has been revealed elsewhere in this study.

Student H, whilst affirming that the school's support for her as a high-performing, naturally enthusiastic and hard-working student had been exemplary, spoke on behalf of those who were struggling academically or unused to high levels of hard work ('I think it is a school for people who are passionate and who want to do it, so those people who aren't working or do struggle….maybe it's not the best place, when it is so research-led'). This, according to Student H, was despite the fact that '[the school was] sending out this message of, look, we do research, this is the way it works' during their earliest approaches to students.

Student K reflected that one of the key ingredients of success in research work at the school was choosing the right project in the first place, something which not every student achieved:

> I think everyone has the potential to have that kind of massive motivation, but I think people just need to find the right area and I think definitely some of my friends kind of just hadn't really found the right area, so were kind of struggling a bit

This point was certainly confirmed in my observation of the history research groups, where there was a considerable difference between students who were more-or-less fully autonomous and energised and those who seemed lost and could give no coherent

account to me of their roles or of what was going on in their group or in the larger research community.

The fact that a significant number of students failed to engage with research at all or struggled when they did had clearly persuaded some that the widening of student research as a learning programme was counter-productive. Teacher 8 spoke about some less committed students joining projects simply as ‘a status thing’ and then dropping them once their purpose of putting something on their personal statement had been fulfilled, whilst others were simply incapable of coping with their demands. Teacher 6 (the ex-head of science) agreed:

> I saw students involved with projects not completing school work to order. The quality of their work decreased and their grades suffered. The projects were challenging and in many cases too demanding

Some of the less engaged or less high-performing students referred to here could undoubtedly be found in the large body of students who had developed through the school from Year 7, but a significant proportion of them came from the body of external students who joined in Year 12 from other schools. In the final sub-section of this part of my study, I consider how students from this external body conceptualised the differences between the learning culture of the case study school and the learning culture of the school at which they had studied for their GCSE qualifications.

5.6.4. How differences between the learning culture of the case study school and the learning cultures of other schools were illuminated by the data

In attempting just such a conceptualisation, Student G focused very specifically on the ‘enthusiasm for learning’ that was immediately obvious to her when she arrived at the school and which was a shock after the less committed atmosphere amongst the students

at her previous school, especially as it manifested itself in 'the common room and the café' rather than the classroom. For Student A, coming from a school where 'it was very much just you did your lessons', the experience of the openness and freedom at the case study school had been 'quite an adventure'. Student F compared the emphasis on learning in this environment with the 'grade factory' of his former school and Student H reflected that, at the grammar school at which she had taken her GCSEs, 'it was very much a sense of you do the exams and you get the good grades, whereas here it's just all these additional lectures and stuff – it's playing on the A Level course, but it's going far beyond it and I think that's been really helpful'.

For these four students, the move to the case study school had apparently necessitated a change in their whole way of looking at learning and not merely a superficial adjustment. It had been a disruption of their learning 'frames of reference', as Mezirow reminds us all transformative educational experience should be (Mezirow, 2000: 16).

One question which inevitably came to mind, though, was whether the differences being described by these students were attributable largely to the shift from GCSE to A level, rather than to a change of ethos or culture. Where students addressed this question in their responses, there was a more-or-less unanimous feeling that this shift of academic level was a factor, but did not account for the shocking but stimulating effect of the culture of their new school inside and outside the classroom. Student H's response was typical here:

> ….part of it is definitely the fact that when you're doing A Levels it is because….you're studying subjects you want to do, so obviously I felt the difference in that….but at the same time I've still got a lot of friends at [her previous selective school] and it is the same story….so I think there is definitely a difference here to other schools

On the subject of deciding which school to choose for their sixth form studies, students conceptualised their attraction to the case study school differently. For some, it was a general impression, received through experiencing presentation evenings and tours of the school, that the ethos was open and appealing. Thus, Student F referred to being 'aware of the research base' but being more impressed by 'the whole ethos of education' which he could 'see just from turning up and hearing the talks'. Similarly, Student Q spoke about a general awareness that 'they didn't always just teach the curriculum, it had these other things that help widen our knowledge'. For others, though, the appeal was very precisely that of joining a project, as Student N reflects:

> I came here to do something like this, that's the reason why I came….I wanted to be part of a science project or something, because….my old school didn't do anything like that, just stuck to the curriculum – I can't even think of anything, apart from music maybe….where we went out somewhere and did something

For some students coming from outside the school, what the case study school had to offer appeared to be very clear, and was a challenge they seized energetically. As Student K, an insider from Year 7 onwards, put it, 'although they aren't used to [the challenging ethos of the school], I think it's kind of quite an interestingly new thing to them, so I think they kind of attack it with more vigour, almost'.

It would be wrong to suggest, however, that transference to the case study school and what happens afterwards had been uniformly positive experiences for outsiders. Student Q spoke about being dropped 'in the deep end' and feeling the 'added pressure' of being pushed to achieve, and Student I identified two specific points of difference which made her new school a challenge. One was the intellectual demands of a school whose students were already used to high standards of academic excellence and the expectation that

most students would apply for ‘a top university’, something which ‘relates to the research because you are ready to face the demands of a higher academic institution’. The other was the emphasis on independent learning and resourcefulness, as compared to a school where ‘a lot of the teachers gave us the resources that we needed’ at GCSE.

One student, though, had some very interesting reflections on the personally transformative experience of moving to the case study school and developing as a learner there through research work. The reflections revealed a process of change and growth that came across as almost traumatic and was expressed in a particularly memorable, violent metaphor:

> ….if someone had proposed this to me at the very beginning of Year 12, and if they’d have told me what the emotional change I’d go through as a result, I would have said, no, I don’t want to, because I think before doing this project, and actually before coming to [the case study school], I had it in my head that if I had to try really hard at something it meant I wasn’t naturally good at it so I would just leave it alone….and I think it really almost takes someone to violently punch through that and say, actually, no, you have to try and that means you’re good at it (Student G)

For this student, the experience had been a blow to her entire view of herself, and not merely to her idea of herself as a learner. This reflective, and reflexive, statement has all the hallmarks of Mezirow’s ‘epochal’ transformative learning experience, in which profound disorientation is part of the ultimately beneficial process of change (Mezirow, 2009: 94) and resonates powerfully with Dweck’s idea of ‘mastery’ as the antidote to an acquired habit of ‘helplessness’ (Dweck, 2000: 5, 10).

The responses of external students cited above appeared in accordance with the reflections of two members of staff in positions of power and influence at the case study

school in terms of research-based learning. The head of research (Teacher 5) anticipated the findings of this study when she described the mixed results of the involvement of external students in the research projects. There was a difference, she suggested, in 'pace' and 'expectation' at the case study school, and it was not unusual for some external students to 'flounder' and to find the demands of the wider curriculum 'a little bit crushing', but she went on to say that, for some, 'it's the making of them'.

The head teacher put this rather more starkly in his interview with me:

> ….about a third of them come here because they really want to do that and they embrace it very quickly, and they tend to be the brighter ones. A lot of them come here and they never get it. They come here and they think that, somehow, they will become a different person if they arrive in the school, but they don't open themselves up to the fact that their relationship with teachers is very difficult because they find…. that transition extremely difficult, they just don't get it

In the same interview, the head teacher also revealed that the school had concerns about the well-being of students in the sixth form, there being a 'significant mis-match' between the equilibrium of students who had come up through the school and that of those who had joined in the sixth form from elsewhere, identifying problems such as anxiety, self-harm, eating disorders and depression. It was not clear from this whether the school would be considering issues such as whether the number of students admitted to the school from outside had created difficulties in terms of how they had responded to the school's expectations, whether the support given to external students (and indeed internal students) as they embarked on challenging research projects had been adequate and whether the potentially negative ways in which students might attribute their lack of success (short- or long-term) to innate weakness had been important factors.

Chapter Six: Synthesis and evaluation of empirical findings

This chapter will bring together, synthesise and evaluate the evidence from the data as I have presented it in Chapter Five, drawing out key themes and issues. It will begin by pulling together and evaluating the findings about students' learning, both in terms of their personal motivations as individual learners and in terms of their social interactions and collaborations. It will go on to consider the overall effectiveness of this kind of constructivist, emergent learning for an institution looking to be resistant to the established conventions of education and the kinds of scaffolded support a school can provide to nourish it. The final section will consider how a school-based, transformative, real-world environment for learning develops within the wider culture of a school and within the context of the reproductive expectations of contemporary UK secondary education as a whole.

6.1. Constructivist, emergent learning: the resistant institution and its learners

Individual learners, morphogenesis and the resistant institution

In terms of the individual learner, the promotion of independent agency in some of the projects at the school, such as those in physics, was attestation of the power of autonomy and emergent knowledge as opposed to the more constrained work of the A Level classroom, where, despite teachers' following of syllabuses which appeared to espouse discovery and critical thinking, as in A Level history coursework, the data suggested there was a significant amount of residual spoon-feeding, reproduction masquerading as transformation. Indeed, there was clear evidence in all research projects considered in the study of freer, more loosely mediated approaches. The work in English, for example, in its drive to publish genuinely critical and original material, represented autonomy and emergent awareness just as powerfully as the work in physics.

Some students, in other words, were moving rapidly in their research towards a morphogenetic role and away from more passive morphostasis through a combination of the opportunities offered by passionate teaching staff, well informed about the latest thinking, methodologies and publications in their subjects, and the sheer energy, inventive curiosity and creativity of students unleashed by these opportunities. True to Bhaskar's model (Bhaskar, 2011: 3), this transformational stage was followed by a stabilising reproductive stage, as neophyte student researchers joined teams of more experienced students, but this was, itself, transformational in terms of the conventional structures and relationships of a UK secondary school sixth form where, typically, school leaders and teachers control all reproductive processes.

There was also evidence from the student interviews of a culture of learning emerging from outside conventional school learning spaces, students new to the school finding a strong intellectual community within the café and the common room as well as the classroom and other students delighting in the social networks beyond school, as in Student O's experience of professional conference interactions. Similarly, the politicisation of a significant group of students in response to what they saw as draconian censorship and the setting up of autonomous collegiate societies in, for example, economics demonstrated the breadth of the emergent, morphogenetic confidence and influence of students given space to develop.

This kind of cultural efflorescence could be seen as an important by-product of the project work, as students seized opportunities to think and to act, and achieve a personally meaningful connection between the two. It is a fascinating take on Giroux's notion of emancipation through informed practice (Giroux, 1981: 24–25). In some ways, these engaged, autonomous activities of students at the case study school subverted Giroux's notion of the repressive hegemonic order working through institutional agency

and the need for resistance from both teacher and student (Giroux, 1986: 106 – 109), in the sense that it was the very culture of the institution itself that had provided the contradictory tensions necessary to allow the possibilities for resistance and the rejection of the passive role of student-as-recipient (Giroux, 2006: 34). The institution, in its refusal to toe the line of instrumentalist education programmes, had become itself resistant. However, this is a complex issue, and one which will resurface in the third section of this chapter in the consideration of pedagogical and cultural nuances within the case study school.

Epochal and cumulative change: challenge and distress

Digging a bit deeper, it was clear that the emergent knowledge-construction happening at the case study school through research-based learning and more widely was supported by ample evidence of radical, sometimes disorientating, personal transformation in individual students, Mezirow's 'epochal' change (Mezirow, 2000: 21). Student G's helplessness in the face of her own lack of success being 'punched through' by the shock of the demanding learning culture of the case study school provided powerful evidence of the effect of the sudden disturbance of frames of reference that comes with some transforming experience. At the same time, the compromises some students had to make in their planning and progress in projects were evidence of the messy reality of research and the effect of more gradual, but no less meaningful, transformation in individuals' understanding of themselves as learners, Mezirow's 'cumulative' change (ibid: 21).

However, the data did not confirm the successful implementation of a broadly constructivist pedagogy at the school unequivocally. In terms of the 'punch' carried by transformational learning, for example, which at its best brought about the 'deep, personal and internal' change the head teacher writes about, there was some evidence

that a significant number of students had found the unusual challenges of research too great, even when the environment for learning, as in history and design, appeared positive, flexible and encouraging. This had resulted, in a relatively small number of cases, in retrogressive passivity, disengagement, lethargy, absence and tearfulness, and not the progressive transformation the school would wish to see. This seemed to be partly through poor choices of research subject made by individual students, something which has implications for the case study school in terms of the supervision, guidance and advice students receive prior to the commencement of projects.

The impact of extrinsic and intrinsic student motivation on learning

One factor which appeared paramount in terms of successful student transformation was initial and continued motivation. What was apparent in the data in this regard was a cross-fertilisation of reproductive and transformative effects and subtle, complex combinations of affective and cognitive influences that often blurred the simple distinctions of extrinsic and intrinsic motivation, distinctions which, as West observes in his biographical study of adult learners, can be seen as 'artificial and reductionist' (West, 1996: 206). What drove students, particularly those who had shown themselves to be very high-performing in conventional learning environments, was sometimes almost purely intrinsic in its origin, as in the work of student researchers in physics. In other cases, however, there appeared to be a more complex combination of extrinsic and intrinsic, such that very personal motivations – deriving from experiences of family illness or a desire to make a difference in the world – were mixed with a keen awareness of the advantages of research-based learning in terms, for example, of university applications. No student interviewed for this study spoke about being motivated entirely by extrinsic factors, although there was evidence of what I have called *passive motivation* in data from some teachers and school leaders, in which certain students were

reputed to join research projects in the short term in deliberate pursuit of extrinsic advantage, or to be drawn into compliance with a research culture that was actually beyond reach for them, certainly in a minimally supported environment. Such students might be said to have pursued reproductive goals when what was called for was a transformation of conventional roles and relationships within the institution.

The impact of social interaction and collaboration on learning

There is evidence, then, that loosely mediated opportunities for intrinsically motivated personal transformation through research had produced powerful learning experiences for students at the case study school, even if these had not worked universally or unequivocally. The question of whether these opportunities operated more or less effectively through collaboration and team work was addressed in different ways in the student interviews.

Some interviewees expressed a strong preference for working alone, whilst others were equivocal about the advantages and disadvantages of collaboration, especially in the key developmental phases of research work where some felt working with others could be compromising and restrictive. More usually, though, students expressed the view that an over-emphasis on solitary activity could result in over-protective and ineffective work patterns and that autonomy was generally increased, not diminished, by the sharing of ideas in team interactions, as long as space was afforded for independent work.

This variety of response was not, perhaps, particularly surprising, given the very different blends of intrinsic and extrinsic motivation discussed above, the residual effects of an instrumental examination-driven education system, where individual effort and achievement is the goal rather than collaborative skill, and the unique demands of the work. Some projects had clearly required sustained solitary writing, drafting and re-

writing, with support confined to advice from internal tutors and the encouragement (and demands) of external publishers, as in English, whilst others would not have operated at all without collective responsibility and team-work, as in the design projects.

The generally positive view of collaboration amongst most students, however, can be linked to the transformations of roles, relationships and working methods through research based learning and to productive changes in conventional pedagogical structures brought about by a self-generated culture enriched by the established environment of resistant institutional challenge. This is a reciprocal relationship of morphogenesis and morphostasis, the reciprocity seeming to be threatened only occasionally by the re-establishment of traditional hierarchies, for example in the GROW and MBP projects in biology.

6.2. What the findings tell us about the effectiveness of scaffolding and support mechanisms in facilitating autonomous learning

Hands-off or hands-on?

Despite the occasional lapse into more overtly hierarchical relationships, there was ample evidence that the school, and the teachers working within it, support students in a way which emphasises transformation rather than transmission, at least in research-based activities. The data suggested an environment supportive of free, independent learning, with hands-off scaffolding, in contrast to the hands-on support that many students clearly still experience in their A level classrooms. It is an environment which allows the opportunity for many students to develop as learners within the unpredictable, sometimes challenging and difficult reality of research.

There were some questions raised at interview about the balance between what is perceived by some students as the “sink or swim” culture of the school and one which

is more protective, but in general the data suggested this balance to be well-judged, except in the cases of some students arriving at the school from other very different, perhaps less resistant, school cultures and in those of students embarking on research involving vulnerable members of the public, where supervision was perhaps not as close as might be considered necessary. The data revealed that the balance had been kept, variously, through differentiated approaches, just-in-time support and faded scaffolding in frameworks that established freedoms by holding firmly in mind the autonomy of the students.

It is apparent from some of the students' interviews that, for those who had developed through key stages 3 and 4 at the case study school, the ground had been prepared through creating a culture of research towards which younger students could aspire, through mentoring arrangements and in small, prototypical projects, largely in Key Stage 3. For these students, the support strategies described above appeared to be more natural and customary and therefore more readily internalised.

The structured programme – morphogenesis or morphostasis?

Evidence of the success of the more structured programme of research-based learning introduced in 2015 was mixed. The programme introduced clearer guidelines, an expanded offer through an introductory fair at the beginning of Year 12 and follow-up analysis by a newly-appointed head of research. There was certainly evidence of broader participation and the involvement of more subject areas, but there was also some evidence of normalisation, unhelpful competitiveness amongst project leaders and an increase in the number of students failing to meet expectations, especially amongst those new to the school.

It may be that the resistance against the conventional instrumentalism of state education effected by the research-based pedagogy established at the school before 2015 was, in fact, diminished by the drive to recruit more students to projects, hold them to account and monitor their progress and the progress of whole programmes more closely. An essentially morphogenetic culture seems partially to have entered a morphostatic phase in which its resistance to convention has become itself a slightly suffocating norm. Bhaskar would not be surprised at this, of course, but it may well be important to retain, as far as possible, the internal conflicts, Giroux's contradictory tensions (Giroux, 1981: 24), which give rise to possibilities for resistance and further transformation in the future. This might be achieved through giving maverick projects and project-leaders fuller autonomy and allowing the number of students taking full advantage of research opportunities to expand or contract more organically.

6.3. The research-based learning environment in the culture of a UK secondary school sixth form and within the contemporary UK context of state education as a whole

The development of a resistant learning culture

The data show that a real-world, professional, research-based environment did not grow quickly at the case study school and was not imposed centrally by the leadership team early on in the tenure of the current (2017) head teacher. It began as a number of links forged by dynamic individual teachers with professional researchers and became a school-wide pedagogical programme only gradually as the success of projects in, for example, physics became apparent. At this point, students working in a variety of subjects – biology, design, history, geography, English – made real, sustained connections with experienced practitioners and entrepreneurs in the real world, again largely through links forged by teachers.

Partly an ‘enacting organization’ (Brown and Duguid, 1991: 51), the case study school allowed experimentation to occur and was prepared to take on, or rather steer around, conventional examination-based approaches, at least in terms of the research environment. However, its leadership of change was essentially constructivist, building on what was occurring organically in the school, and thus more akin to the characteristics of the ‘discovering organization’ (ibid: 51), responding to detected change but not driving it *ab initio*. The school itself thus went through a process of reproduction and transformation, moving from the adoption of approaches pioneered by individual teachers and students to a point at which it championed these approaches and set about altering the culture of the school in relation to the traditional expectations of UK state secondary education, forming its own critical resistance to them.

The resultant transforming work that evolved in the projects took many students beyond the community of school and into the community of the professional workplace. Some of the work produced in the research-based projects was, the data suggest, genuinely innovatory and occasionally ground-breaking and thus transformative on a broader scale than that of localised roles and relationships. However, full insiderness in professional communities appeared to develop for a relatively small number of students. For most, the experience of working inside real-world disciplines was a genuine one, but one which existed more on the periphery of the organisations and institutions with which they had been involved. Nevertheless, the experience clearly fostered growth in soft skills, opening up freedom, independence, a less constrained use of time and space and the personal transformation that comes with exposure to new environments, responsibilities and ways of working.

Challenges to the idea of a resistant learning culture

In his draft document on pedagogy and in his interview with me, the head teacher was clear about the overall primacy of this challenging, research-based approach in the school:

> At the [case study school] we acknowledge that both the formal curriculum and the examination syllabuses are no longer appropriate to our students and we offer them an alternative intellectual challenge beyond the established expectations for young people of the same age. This alternative challenge is an entitlement for all our students

However, there was some evidence that students were aware of an underlying adherence to a more conventional results-driven ethos. This could be seen when Student Q, elsewhere very positive about the challenges the school had provided, voiced her disappointment that the school's underlying drive was still 'aimed at grades', or when Student N spoke of a 'conflict' of objectives in the school (though he was also of the view that this position was 'realistic' and something 'you can't dodge').

Similarly, whilst there was undoubtedly a marked contrast between the activities undertaken by most students in research and those undertaken in A level courses, the distinction is perhaps not as stark as the head teacher suggests in positing a pedagogical dichotomy. Some students spoke of a two-way exchange of skills between their research work and their A Level studies and the fact that a fundamental understanding of underlying principles and theories (the reproductive element) could be crucial in making sense of emergent knowledge (the transformational element) in research. Others asserted that the research had taken them well beyond what A Level could provide for them – Student C in physics, for example, or Student G in English – but also acknowledged that they were drawn to the research partly through texts, activities or learning relationships situated within the A level classroom.

In the first section of this chapter, I suggested that the school's research environment represented a subversion or extension of Giroux's notion of resistance, in that students and teachers had been partially emancipated in their knowledge construction and personal transformation, able to 'confront assumptions concerning the aims of education' (Giroux, 1980: 349) through research, by an institution which was itself resistant towards the conventional processes of the contemporary UK state school system. I believe this remains the case, but the cultural ambiguities that appear to be exposed in this section of the chapter suggest that it was a rather more nuanced situation. The school's position is not, perhaps, purely resistant, but resistant and complicit at the same time, in what the head of humanities (Teacher 7) calls a 'schizophrenic' culture. It is, nevertheless, a nuanced situation which, despite the disappointment of some, has been largely accepted by students and teachers, their understanding of the broader educational context of grades, Russell Group universities and their own privileged position in a well-established selective environment allowing them to both reproduce and transform at the same time, to conform and resist.

Is this having one's cake and eating it? The answer is, of course, yes and no. The school undoubtedly has done much through research-based learning to resist the straitjacket of the 'representative epistemology' (Osberg and Biesta, 2008: 314) of conventional pedagogy, national examination systems and syllabuses, foregrounding the kind of 'emergentist' (ibid: 314) approach that values the uniqueness and variety of an individual's construction of knowledge. In the background, however, runs a complicity with the grades system, which the head teacher in his interview with me described as 'necessary but not sufficient' and which is very much there as a constant pressure for many, if not all, students at the school.

I would argue, nevertheless, that the situation is saved from contradictory confusion by the awareness of students and the way that many of them have been able to problematise the 'planned enculturation' (Osberg and Biesta, 2008: 314) of national educational policies, examination courses and syllabuses (and school programmes that are designed to deliver them). Resistance can, after all, be a matter of knowing what is happening to you and thinking and transforming yourself differently. Not all students at the case study school have achieved this ironic understanding, but many have.

6.4. Transformations: learners, structures and institutions

If transformation can be partly an ironic appreciation of one's situation as a learner, it can certainly also be something more radical and structurally and institutionally powerful.

The literature presents us with two very different models of transformation. In critical realism, it forms part of the notion of emergence, in which social structures form through the action of individuals and then coalesce, coming to have a strong influence on others. This is the reproduction-transformation model, where an individual begins by successfully integrating with the structures of the social groups to which she belongs before going on to contribute to the changing of those structures through her own agency. The reproduction represents Archer's morphostasis, where change is stilled, the transformation morphogenesis, where change is on the move.

The other concept of transformation relevant here is that of Mezirow's transformative learning, where the emphasis is solely on the changes to frames of reference brought about within the individual learner through reflection on epochal (sudden and disruptive) or cumulative (gradual) experience. Mezirow's notion does not imply, necessarily, either

co-incident apprenticeship into a community of practice or the morphogenetic shift within social structures, as in critical realism.

From what I have written in the rest of this chapter, and in the light of these distinctions, there was clearly a full spectrum of transformative student achievement at the case study school. There was evidence, unfortunately, that some students did not appear to transform themselves or others at all, for example those who completed A level courses but took no part in projects, or those whose research motivation was short-lived and entirely extrinsic. This finding notwithstanding, there were many who had been transformed deeply and personally, in Mezirow's sense, by what they had achieved in the projects, although most could not be said to have broken the mould in any meaningful way, as for example students in the historical geography projects and in the work on *Frankenstein* in English. However, there was undoubtedly a group who had initiated ground-breaking change within the real-world community in which they worked and thus, in a modest way, altered the way it thinks about the world. The work of the cosmic ray researchers in physics and the product developers in design deserve mention here.

Whilst this would suggest that the only group to achieve full transformation by the lights of critical realism was the last, it is important not to overlook the powerful transformation of conventional relationships and working methods within an educational institution which has been brought about by the commitment of the majority of students involved in projects. Thus, I would argue that, by the very nature of the free, open collaboration between students and teachers, students and outsiders and students and students evidenced in this study, an institution itself has been – at least partially – critically transformed in a way that both Bhaskar and Archer would accept as genuinely emergent and morphogenetic.

Chapter Seven: Implications and final conclusions

7.1. Introduction

This research has attempted to explore critically and in depth and rich detail the learning experiences and conceptualisations of sixth form students in a particular kind of radically challenging environment not fully documented or evaluated in the literature. As with most individual case studies, the research cannot claim to have been broad in the straightforward sense, though its intentions, mostly intrinsic rather than instrumental, reach out to many other schools employing a similarly challenging pedagogy in the kind of 'prospective coherence' I have written about elsewhere, where particularised research data and findings naturally engage with an ever broader negotiation of truth (Jones, 2014: 25). The study is *ipso facto* original, concentrating as it does on the voices of individual students in a particular context, but its originality extends also to the evaluation of its empirical findings in the context of broader issues of resistance and local and national educational cultures.

The aim of this final chapter is to draw on the evaluations of Chapter Six in order to set down what I believe are the implications of the study for learning theory, for the case study school and for other schools with similar pedagogical aims. Following this, the chapter considers the limitations of the study and the possible areas for further research and ends with a brief, personal overview of the research process.

7.2. Implications for theory and the findings of other empirical research

The synthesis and evaluation of empirical findings from this case study both confirm and challenge existing relevant theory and the findings of other empirical studies in similar research areas. This section sets out to explore the implications of what the analysis of the data from the case study appears to be revealing in terms of this theoretical/empirical background, with a view to exposing new ways of looking at

constructivist/social constructivist learning environments and to contribute to the later sections outlining the implications for the case study school and for other schools with similar cultures or ambitions for learning.

From the data, I believe it is incontestable that the case study school has strongly encouraged the kind of independence and autonomy that can lead to what Wenger, echoing the critical realist lexis, calls 'emergent' learning (Wenger, 1999: 267), and this not only in the research-based projects, but also in the opportunities, for example, for publication of student work. I partially agree that, as identified by Wenger in his work with Jean Lave, this emergent learning derives from a 'learning curriculum' rather than a 'teaching curriculum' with its 'didactic caretakers' (Lave and Wenger, 1991: 112), yet the word 'curriculum' seems to imply the replacement of one reified pedagogical scheme by another. The work of students at the case study school indicated a *culture* of learning, rather than a curriculum, the testimony of a significant number of students suggesting that both their learning habits and their understanding of themselves and others had changed as a result of the projects and other opportunities they had responded to.

Paradoxically, there were perhaps elements within the more structured environment for research-based learning established in 2015 which could be said to have reified what the various projects had been trying to achieve, and some students and staff identified the continued presence of a teaching curriculum in the insistence on good grades at A Level. However, the data also demonstrated that, for a significant number of students, productive connections between this curriculum and the learning culture of research existed and in part belied the distinction made by Lave and Wenger between the two approaches.

Returning to the culture of learning built on awareness of self and others implied by the data, it is interesting to re-examine the literature around transformative learning and the theory of epochal and cumulative change presented by Jack Mezirow (Mezirow, 2000: 21). Whilst much of the data suggested the prevalence of a smooth *cumulative* transformation, some of the more striking student observations indicated a more disorientating, *epochal* shock to the system. This shock can be positive, but the data showed that some students found the demands and insecurity of what the school presented them with uncomfortable.

We may be seeing, here, a distinction between the andragogy which is Mezirow's prime focus and the needs of vulnerable late adolescents and between the idea of transformation as a dynamic, always positive change and the concept of transformation as a slow, 'unsteady' process, particularly as far as the not-quite-adult is concerned (see Illieris, 2014: 159 and West, 2014: 177).

Transformative learning places the emphasis very firmly, in critical realist terms, on morphogenesis rather than morphostasis, although Mezirow seems fully aware of the 'sense of stability, coherence, community, and identity' provided by the anchoring 'frames of reference' which all of us carry around with us (Mezirow, 2000: 18). However, in describing the ways in which learners can challenge their own stabilising frameworks of understanding, Mezirow makes a distinction between the psychotherapeutic 'subjective reframing' of Dirkx, with its 'intensive and difficult emotional struggle', and the mindful action to overcome such 'constraints' through transformative learning (Dirkx and Mezirow, 2000: 23-24). The data from the study suggested this is something of a false distinction, however, and one which takes little account of the problems faced by those attempting such action from a position of accustomed, unreflecting passivity. Learning, writes Mezirow, is about open discourse,

which needs to be 'free from….immobilising anxiety' (Mezirow, 2000: 92), but he provides no suggestions as to how to liberate and mobilise those suffering from this. The data suggested that a good starting point would be to get to know the 'epistemological complexity of the present learning challenges (students) face in their lives' (Kegan, 2000: 59) before asking them to transform themselves as learners.

The data cast an interesting light on the dialectic between constructivist and social constructivist theories, there being a full spectrum of student opinion on the relative merits of focused, independent, autonomous research activity and socially interactive collaboration. The choice of a particular project as offering a chance to work alone or the opportunity of working in a collaborative team was a recurring feature. This suggests that neither constructivist theory nor social constructivist theory can be seen as a complete description of learning development, at least in the context of students' conceptualisations of how they construct knowledge in open environments.

With regard to institutional and teacher-led support, the data strongly indicated the efficacy of a liberating model of scaffolding, one which begins with the conceptualisations of students and allows them to develop freely. This is the later Bruner model (Bruner, 1996: XII), rather than the earlier deficit model (Wood et al., 1976: 98), and suggests a transformational change, not only in knowledge creation itself, but in the structures and relationships of school as an institution.

At the case study school, the institutional support moved many students beyond the institution itself, stretching Vygotsky's *zone of proximal development* beyond the near-at-hand teacher and 'more capable peer' (Vygotsky, 1978: 86) into the realm of the professional practitioner and actual community of practice. Here, the challenge was more starkly felt than through 'adult guidance' alone (Vygotsky, 1978: 86), the real,

professional world making demands of students as problem-finders and problem-solvers and as neophyte practitioners with deadlines to set and meet.

In terms of actual professional communities, I cited in Chapter Two the disagreement between Brown, Collins and Duguid (1989) and Brown, A. et al. (1989) about whether it is feasible or 'romantic' (Brown, A. et al., 1989: 189) to suggest that school students can work within actual, real-world cultures and disciplines. Evidence from the data on this issue suggested that students can be divided into three groups:

1. Those who had entered fully the domain of researchers and creative designers to produce work of genuine originality
2. Those whose work had corresponded to the *legitimate peripheral participation* of communities of practice theory, and
3. Those whose experience of research-based learning had been largely 'ersatz' (see Brown, J.S. et al., 1989: 34) and confined by the conventional expectations of sixth form achievement and their own limited motivation.

Those students in the first category would seem to prove Brown, Collins and Duguid correct in their assertion of the possibility and power of real-world cultures and disciplines in schools, these students moving well beyond the peripheral involvement of students in the second group, who tended to steer between the two critical positions, their work being more than *ersatz* but perhaps short of the full, ground-breaking independence of the first, an 'approximation of full participation that gives exposure to actual practice' (Wenger, 1999: 100). Students in the last group perhaps failed even to engage with the critical 'community of scholars' envisaged by Brown, A. et al. (1989: 191).

The data exposed differences between full engagement with real-world domains and more peripheral, even artificial, forms of engagement. Wenger's list of how the supported work of neophyte learners in communities of practice differs from that of fully experienced practitioners is certainly pertinent here: 'lessened intensity, lessened risk, special assistance, lessened cost of error, close supervision' (Wenger, 1999: 96).

In terms of the case study school, it would appear that some of Wenger's list was a good fit. The emergent pedagogy at the school, whilst it gave a strong impression of having at its core real world domains of practice and their community-specific ways of working, appeared, nevertheless, to have adopted some of Wenger's modifications and approximations; the risk level was obviously less pronounced for the students than, for example, it is for university researchers working around ethical and budgetary constraints, and the cost of error, whilst present, was diminished by the protective carapace of the institution, the closeness of supervision and the fact that much of the learning was not specifically tested in core AS or A level examinations. However, from the data, it would appear that teachers and leaders at the school would be unhappy with idea of 'lessened intensity' – the experience of intensity seemed very much at the core of what the research-driven learning was about, and this was also powerfully supported by the evidence of the student interviews.

In this sense, then, the case study school would appear to be travelling at least a short way beyond Lave or Wenger in its ambitions for its students-as-researchers. Yet, in another way, Wenger's ultimate vision would appear to take us well beyond the case study school in terms of how learning is structured. For Wenger, 'it is more important for students to have experiences that allow them to take charge of their own learning than to cover a lot of material', as a result of which he envisages a learning community that 'can become rich and complex enough to be the driving force of a complete

education' in a curriculum that 'would then look more like an itinerary of transformative experiences of participation than a list of subject matter' (ibid: 272). We might tentatively say that the case study school appeared to be pedagogically even more adventurous than the situated theorists, but structurally less so.

The pedagogical adventurousness at the school that seemed to take it a little way beyond the peripheral participation envisaged by Wenger had clearly produced a range of responses in students, responses which it is useful to set against the evidence of some of the empirical research discussed in Chapter Three.

The small body of work published in the US under the loose title of *authentic learning* is one such area of research. Authentic learning is helpfully defined by Newmann et al. as 'construction of knowledge through disciplined inquiry to produce discourse, products, or performance that have value beyond success in school' (Newmann et al., 1996: 287) and thus would appear to have a strong resonance with the work at the case study school.

The findings of Nicaise et al. (2000: 91) followed a school space programme in the US that actively espoused the idea of authentic learning. They revealed, as did the data from my study, that there was clear enthusiasm and excitement, a sense of moving well away from accepted relationships and ways of working in schools, but also some time-filling and busy work in inauthentic or poorly explained activity (as in some of the work at the case study school in the MBP project or the research on the local impact of war in history). My amended list of the questions produced by Nicaise et al. (see Chapter Two and Nicaise et al., 2000: 93) seems pertinent here.

In response to, ‘What makes a task an authentic task for some and not for others?’ and ‘Why are some students successful in authentic classrooms where others are not?’ my study seems to suggest a complex series of answers:

- That choice of research project can be crucial in engaging with the real-world quality of the experience
- That the mix of intrinsic and extrinsic motivation is important, with successful students strongly emphasising the former
- That the previous learning experiences of students prepare them differently for the open challenge of genuine research work.

In response to, ‘How are student-selected culminating activities different from teacher-created ones?’ and ‘How do successful students manage their own learning in authentic classrooms?’ my study suggests that scaffolded autonomy is key. Where projects were wholly initiated and sustained by teachers, as in the chemistry project rejected by students because it would have treated them purely as laboratory assistants, the projects were less successful. Where they had kept students on board throughout, or handed over control to them completely, projects were more dynamic and effective. Students’ spontaneous goals may be naïve and over-ambitious, but the data suggest that it is more productive to begin with students’ own concepts and aims than to control the learning environment, goals and research methods from the start.

The key to students’ managing learning in their research projects is taking control, accepting responsibility, showing leadership (in large and small ways) and meeting setbacks with a resilience fostered by positive relationships and well-judged support. It was these elements of research-based learning that gave rise to a confidence in the future espoused by almost all students in interview and offered some support for the idea of a

'robust' improvement in learning skills mentioned by empirical researchers in relation to the effects of problem- and project-based learning (see, for example, Krajcik et al., 1998: 34). It was a robustness created by a 'live', active engagement more likely, according to many students, to lead to a resilient understanding of real-world domains than the 'inert' knowledge of the conventional classroom (see Boaler, 1997: 103-106).

This case study has focused strongly throughout on students' independent voices, supporting their conceptualisations by reference to other data sparingly. It has also broadened the usual, STEM-based, range of research in project-based and real-world learning to work in the arts and humanities, and has considered the complex interweaving of intrinsic and extrinsic motivations present in students' reflections. It has thus addressed all of the gaps in the research discussed in Chapter Three, although it has done so, of course, by considering data from a single case study only.

7.3. Implications for the case study school and other schools

This section offers some tentative suggestions for both the case study school and other schools as regards the culture, principles, structure and implementation of a programme of research-based learning. Inevitably, those for consideration by the case study school reflect what the data tell us about the actual details of a programme in operation, whereas those for consideration by other schools generalise more and outline what a school beginning such a programme might learn from this study.

Implications for the case study school

The study indicates that it might be productive for the case study school to undertake an examination of its different learning cultures, that of open, challenging, research-based learning, and that of teaching which focuses on students obtaining good grades at A level in order to qualify for entry to Russell Group universities. The school might perhaps

consider whether there is an unbridgeable dichotomy between the two cultures, or whether accommodation can be made between them more successfully.

In some respects, and particularly in certain projects, the school may need to hold fast to core principles of research-based learning a little more assiduously, for example in ensuring that meaningful participation by all students in project work is not allowed to fade and more conventional relationships and hierarchies to re-establish themselves.

The study also suggests that some students need to make more appropriate choices of research subject, perhaps through the school's provision of more detailed information and more widespread use of taster sessions. It might be advantageous for all students to consider how much intrinsic motivation they are likely to have for the research subject (in this respect they may well need closer guidance), and to bear in mind the relative weight of purely independent and collaborative work in each project.

The school could give some further consideration to appropriate levels of support for individual students involved in research. This study found types and levels of scaffolding to be generally well-judged, but the school needs to be aware that its culture has been described by some (very well engaged) students as 'brutal' and 'sink-or-swim'. In particular, the school could perhaps consider more carefully the effects of dynamic, potentially disorientating change on students embarking on research-based projects, especially those whose previous learning experiences have been very different.

The school might also re-consider the purpose and effect of the more structured programme of research-based learning introduced in 2015 and whether it has led to a larger number of committed students getting involved, a better quality of research and a flexible approach to student choice and the leadership and management of projects.

Implications for other schools

The study suggests it would be very difficult and perhaps counter-productive to impose a programme of research-based learning quickly, and wholly at school leadership level. Instead, it might be more productive to begin with two or three members of staff judged to be in sympathy with such an approach and allow them free rein to develop projects autonomously, in line with a limited number of core principles, including the freedom to make mistakes and learn from them.

It would also be beneficial to consider how research-based learning might fit with the existing culture in the school, and whether changes or compromises would need to be made.

If consideration is being given primarily to projects in the upper school, it might be worth establishing a range of prototypical projects at Key Stage 3, to run parallel with projects higher up the school. At whatever level, all students should be encouraged to get involved in research project work, but schools should have a modest percentage target for engagement at first (or even no target at all)

Schools should listen to and support, appropriately and differentially, all students embarking on research projects. They should be allowed to develop their ideas from the very beginning of projects and encouraged to form positive relationships and to establish ways of working that are different from the accepted norms at the school.

7.4. Limitations and possibilities for future research

7.4.1. Limitations

The most obvious limitation of this study is that it is focused on a single case, making broad, wholly confident generalisations about similar learning programmes in other contexts difficult. I believe the study has recognised this, and confined itself to internal generalisations about students, teachers, leaders and outsiders working at the case study

school and very modest, 'fuzzy' generalisations (see Bassey, 2001: 10) about what these might tell us more generally, following the principle of *distributed research* which openly invites students, teachers and schools more widely to take up and develop ideas in their own context. The nature of this single case may also be said to be a limiting factor, however: if readers are looking for research that covers the whole range of student performance, then it must be recognised that the case provides only data from one well-established, successful selective environment.

Within the study, the number of students, teachers and leaders interviewed was not exhaustive, although I believe a saturation point was reached beyond which further data would not have helped to build a different picture in this particular study.

It is worth stating that my position as researcher was also, *ipso facto*, a limiting factor. I am male, white, middle class, financially secure and an ex-teacher and leader at the case study school. Whilst I made every effort to make my background and aims clear to interviewees, for example in the participant information sheet and in my preamble before each interview, and to be an open, unprejudiced listener, there will inevitably have been covert influences at work in the interactivity of the interviewing process.

7.4.2. Future research

A less rich but more wide-reaching survey of students' attitudes and conceptualisations at the same school could be carried out, perhaps partly by methods other than the semi-structured interview, such as an in-depth questionnaire to all students, exploring not only what committed students have gained from their research-based learning but why the significant number of students who do not engage with this form of learning have made the decision not to do so.

A longitudinal study could attempt to draw some inferences about the robustness of the skills developed during research at the case study school by following the development of individual students into university and employment.

More widely, research could be carried out at non-selective schools with broadly similar learning programmes to understand how different levels of conventional educational performance affect the success of such programmes for schools and students.

7.5. Concluding reflections

It was a pleasure and a privilege to be able, through carrying out this study, to enter into a dialogue with teachers and school leaders at the case study school, and, particularly, to do so with the many first- and second-year sixth form students who gave up their time to participate. I offer my sincere thanks to them for the genuine insights their words afforded me into the complex processes of constructing knowledge and understanding and helping others to do so.

In the first section of the introduction to this thesis, I expressed my admiration for students who, unlike me, had committed so fully and so bravely to challenging research work. My admiration only increased during and after the individual and group interviews, as their ability to stand back from their learning and see it more clearly in its local and wider contexts revealed itself. All this, in an environment of expected adherence to an instrumentalist, credentialist educational philosophy which ought to have undermined this commitment and reflective clarity. They had, undoubtedly, achieved what I had failed to achieve in my earlier professional life, and I applaud them for their strength and resilience.

Rarely purely extrinsically motivated and open to very different kinds of relationships, with one another, with their teachers and with the real-world professionals with whom

they came into contact, these students embodied for me both forms of transformative experience. Through shifts in their frames of reference that were sometimes a shock to them, they were able to become different, both as learners and as people, whilst in their ability both to re-mould the conventional structures and relationships of their school environment and to have a genuine impact on knowledge in real-world domains they demonstrated powerfully the fluid possibilities of emergence so important as a principle of critical realism.

Yet, as I made clear in Chapter Six, those same students are both resistant to and complicit with those conventional expectations, despite, in many cases, being well aware of the irony this position entails. They are young citizens of a compromised educational culture, gatherers of qualifications that admit them to academic and professional success, but also fiercely determined to create their own knowledge, forge their own understanding, make their own meanings.

I wish them well.

Postscript: a further critical reflection on some underlying issues

Introduction

The conceptual framework that gives shape to this thesis – critical realism – places the emphasis philosophically on agency within the different levels of an emergent and fluid social structure. Methodologically, through analytical dualism, it insists on taking what people say initially at face value and on their own terms, holding apart what Archer refers to as "the parts" and "the people" (Archer, 2000: 1) in order to determine the kinds and degrees of influence of emergent social structures on individuals and vice versa.

However, one result of this methodology is that, especially in an intrinsic case study such as this, there can remain a lacuna between the initial presentation, analysis and evaluation of data and a deeper exegesis of the wider socio-cultural and economic context in which these data emerge. In this specific study, this lacuna has resulted in an underdeveloped analysis of the context of selectivity and segregation by social class which underpins the ethos and educational philosophy of the case study school. This postscript, therefore, aims to tease out my critical commentary on the underlying culture of the school more clearly, adding another layer of complexity in drawing out the meaning of the interpretation set out in the main body of the thesis within a broader analysis of the wider socio-cultural context in which research-based learning has become an emergent educational philosophy.

A healthy environment?

Reading again some of the evidence gathered for my study from the student interviews, I was struck by the graphic nature of some of the descriptions used by individual students to conceptualise the pedagogic approach of research-based learning and the case study school's educational philosophy more generally, several participants referring to the

'hard' push of the school's overall culture (pp.163-164), to being thrown 'in at the deep end' when coming to the school from outside and feeling 'added pressure' (p.174), to the 'sink or swim' or 'brutal' approach (p.116) of a school which, for those 'who aren't working or do struggle', is 'not the best place' (p.171).

It must be acknowledged, of course, that open, project-based learning, particularly when it is as ambitious as that offered by the case study school, inevitably produces 'uncertainty, ambiguity and conflicting perspectives' (Lombardi, 2007: 326) and a cognitive dissonance that can be 'unsettling', 'difficult and provocative and often uncomfortable' (Osberg and Biesta, 2008: 326). Yet the students' comments cited above seem to point to a more general *cultural* effect, and not merely to the unavoidable exigencies of open learning itself, and therefore to the possibility that one factor at work here is the background noise of a particular kind of expected socio-cultural behaviour coming from the selective nature of the whole school.

A key statement from the head teacher, cited on p.176, is pertinent here. In his interview with me, he spoke about external students who had come to the school and believed that 'somehow, they will become a different person' but who 'don't open themselves up to the fact that their relationship with teachers is very difficult because they find…. that transition extremely difficult, they just don't get it'. The statement occurs in a passage of the interview transcript about preparing outsiders more effectively for the learning environment of the school through aspects of its cultural literacy course. Nevertheless, the danger here is that such a statement might be seen to pathologise the students, in the sense of blaming problems emerging in student-teacher relationships and in the struggle to understand the requirements of research-based approaches on inherent failings in students themselves rather than on the school's educational culture that comes to be embedded in students. If we accept that these problems are at least as much to do with

the institution as the individual, then immersion in a cultural literacy course alone would be unlikely to produce an effective solution.

This is a complex issue in terms of socio-cultural context. It might be suggested that the head teacher's statement betrays, again, an underlying privileged culture deriving from the selective nature of the whole school, and undoubtedly some non-selective students entering the school in the sixth form might well have felt this to be the case. However, the data revealed that many students joining the sixth form from outside were themselves from selective or private educational environments. Thus, an additional issue would appear to be the culture of pressurised learning specific to the school itself, operating as a further layer of challenge even for those used to the privileges and expectations conferred by selection and economic advantage elsewhere.

There is an obvious link we might make here between the 'additional pressure' and 'struggle' experienced by students and their emotional and physical health. Indeed, the head teacher revealed at interview that there were 'anxiety problems, self-harm issues….eating disorders that are fairly rife amongst girls and boys now, and….a lot of depression' amongst sixth form students. These comments came in a long response which began by discussing the problems experienced by external students, but appeared to suggest towards the end that such problems are now also prevalent amongst internal male students, despite the head teacher's 'sense', articulated elsewhere in the same interview, that students seemed 'much, much happier' because of the development of soft skills through the school's broader curriculum and pedagogy. The head teacher would appear to see the health issues identified as symptoms of something for which challenging research-based learning is the cure, without considering that this form of intellectual challenge may, in itself, be the cause of much additional unhealthy extra pressure on all but the most confident of students.

Conflicts and contradictions

In terms of student engagement, these data present a complex, often contradictory picture. Several of the teachers leading the research projects appeared to have developed a 'theory of the learner' (Wood et al., 1976: 97), both in their personal approaches and in the structures they employed. Yet the head teacher painted a picture of students who 'get it' or don't 'get it', an approach which tends to support the idea of the 'brutality' of the school's culture and a view of student potential as 'fixed' rather than 'incremental' or 'malleable' (Dweck, 2000: 2-3). In this respect, the head teacher would appear to have aligned himself with other members of staff who drew a sharp distinction between the able and the less able, the latter, according to some, being best advised to concentrate purely on basic skills development or their syllabus-based learning (see the reflections of Teacher 6 and Teacher 8 in 5.3.3.).

However, this latter view is clearly not synchronous with the head teacher's drive for the majority of students to take part in research activity of some kind, and his belief that, to improve the emotional health of students, there needs to be more, not less, challenging, open learning. On reflection, I believe that the interference here between the more straightforwardly limiting approaches of some teachers and the head teacher's feeling that more research equals greater emotional equilibrium (despite the fact that some students appear to be consigned to incomprehension) shines a light on the underlying conflicts in the essentially privileged position of the school. By this light, empowering and emancipatory roles and relationships are possible through the dynamics of research, but only for those students who 'get it' and only within the overarching ethos of a hard-driven academic environment focused on high-level success in A Level examinations and admissions to Russell Group universities.

These conflicts emerge in the school's delineation of the establishment of its curriculum and pedagogy. In one of his documents, the head teacher writes that national examinations, and the teaching methods associated with them, are 'necessary but not sufficient', the additional work on cultural literacy and the research-based learning projects being part of an 'extended curriculum' aimed at developing 'soft skills'. Despite this, in the same document, the head teacher writes that the examination-related curriculum and pedagogy are 'no longer appropriate' for students at the school, the implication being that they have been replaced by an entitlement to an 'alternative intellectual challenge'. This somewhat confusing position is defended as being part of a 'complex model'.

In another document, the head teacher states that it is the 'primary responsibility' of the school to cater for academically able students through an 'overtly academic culture' and notes that students who have participated in research activities have been 'more successful in higher education and posts in preferred careers'. This appears to confirm the link, also made in the former document, between research-based learning projects and high achievement in 'university study and future graduate careers'. In other words, rather than the establishment of a dichotomy between conventional academic study and independent research, there emerges an intimate connection between the two.

The head teacher, in statements I cited in 5.6.1., writes about not 'teaching to the test' as 'slaves to the syllabuses'. If we accept that there is a robust link between the pedagogy behind student research and more straightforward academic success, the school is drawing a very fine, and possibly untenable, distinction here – examinations are important in an 'overtly academic' institution, and research-based learning, together with other aspects of the school's broader cultural offer, is supportive of the advantages

gained from good examination results, but the two pedagogical approaches are seen as being, simultaneously, dichotomous.

As outlined in 5.6.1., some students showed an awareness of the ambiguity here. Thus, they referred to a 'conflict' (Student N) between the school's championing of cultural breadth and student research and its obvious striving for top grades at A Level and the maximising of entries to top universities, and to a 'disappointment' with the reality of intense exam pressure, when the school appeared to pride itself on its 'learning off of the curriculum' (Student Q). In other words, rather than seeing the inevitable concordance between the two approaches to learning in this academically orientated school, these students took the head teacher at his word with regard to research-based learning and saw only the contradiction.

Revisiting the idea of the resistant institution

In Chapter Six, I suggested that the school might be seen as a 'resistant institution', and that this might be an extension of, or challenge to, Giroux's idea of resistance. I acknowledged, in 6.3., that the school appeared both resistant to, and complicit with, the pressures of conventional, examination-driven learning. One could go further, however, and suggest that, even when resisting, for example through opening up access for students to research programmes, the school has continued to be complicit in another way, relying principally on the cultural capital of predominantly middle-class students for much of the success of these projects, students already largely in tune with the culture of a school that prioritises literate articulacy and academic challenge, in a process by which 'cultural capital is added to cultural capital' (Bourdieu, 1974: 79) and which merely prepares high-performing students more effectively for their intellectual and professional lives to come.

Whilst this is a tenable and persuasive view, one could alternatively argue that this purely critical perspective is reductionist, running counter to Archer's open and dynamic view of change in social structures through a critical realist lens, and that it is dangerous and unethical to consider learners as "cultural dupes". There were certainly instances in which students showed an awareness of the contradictory and controversial elements of these learning environments, as discussed above, and in which students formed their own lively and autonomous culture of learning, collaboration and knowledge exchange in the café and common room, through individual projects standing alone from any traditional subject or teacher and through passionate revolt against censorship.. However, one certainly can, and must, be aware of the wider power structures at play in the construction of these learning environments and the promotion of an educational philosophy that, while claiming to challenge a system, itself remains complicit with it to a significant extent, and is therefore problematic.

A passage from Bourdieu and Passeron (1990) is apposite here. The case study school is one which appears to believe passionately that its pedagogy and curriculum are capable alone of producing the 'cultivated habitus'. This, writes Bourdieu, is one of two 'illusions', the other being the (contradictory) notion that a system of education 'owes its differential efficacy exclusively to the innate abilities of those who undergo it', an idea, as discussed earlier in this postscript, that arose in some key observations by the head teacher and other teachers at the school. What appears not to be acknowledged by the case study school is that its culture 'contributes irreplaceably towards perpetuating the structure of class relations and, simultaneously, legitimating it, by concealing the fact that the scholastic hierarchies it produces reproduce social hierarchies' (Bourdieu and Passeron, 1990: 205). These are, of course, assertions made about all schools, but they have a particular resonance in a school which, it could be argued, as a selective

institution, is part of a structured reproduction of social hierarchies which accentuates this perpetuation rather more obviously.

Thus, despite the potentially liberating and emancipating idea of students developing an ability to achieve an unusual level of autonomy and a levelling-out of habitual power relationships with teachers and others through their research, and despite evidence of transformations in learning and teaching roles achieved by participants in my study, there remains the fact that the school has established the culture through which these transformations have occurred by taking advantage of a privileged position made possible by an openly selective system. It is a system which, as a recent report appears to confirm, can be seen to implement a form of social segregation, locking out many chronically disadvantaged students, whilst providing little evidence that able students gain academically from immersion in a selective environment rather than in a more academically and socially mixed one (Gorard and Siddiqui, 2018: 13). The writers of this report find that 'selective schools can make pre-existing inequalities worse by providing differential opportunities to learn' and go further in asserting that segregation by social class 'may have alarming and dangerous consequences for….society more widely in the longer term' (ibid: 5).

Concluding remarks

Looking back at the evaluative synthesis of Chapter Six and the conclusions and implications of Chapter Seven, I note that I celebrated, in particular, the agency of students finding their learning identities through research-based learning at the case study school in unusual environments and in unusual ways. I note also that I attested to the new relationships – between students and teachers, students and outsiders and students and other students – forged as a result, and the personal transformations,

sometimes epochal, sometimes cumulative, brought about through the challenge of open learning and its emphasis on creativity, collaboration and criticality.

Yet, whilst we should not underestimate the resistance to conventional, syllabus-based learning represented by what the case study school has achieved, my reflections here have provided a broader and deeper context for these opportunities and challenges, whereby the pervasive culture of an essentially privileged educational environment can be seen as problematic – particularly in terms of social class – and as giving rise to seemingly conflicting relationships, philosophies and methods.

There is thus a dichotomy at the heart of the educational culture of the case study school between the opportunities for personal transformation offered for individuals through empowerment and skills development and the absence of a validation of approaches other than the adherence to what could be framed as an enterprise agenda. Such alternative approaches might value less the real-world competitiveness of research and development or product design and marketing and focus more on the whole student and the whole society, a position that might, in the words of the head teacher himself cited on p.160, be neither ‘comfortable’ nor ‘unchallenging’.

Reference List

Anderson, J., Reder, L. and Simon, H. (1996) 'Situated Learning and Education', *Educational Researcher*, 25(4), 5-11.

Archer, M. (1995) *Realist Social Theory: The Morphogenetic Approach*. Cambridge: Cambridge University Press.

Archer, M. (1998a) 'Addressing the Cultural System', in Archer, M., Bhaskar, R., Collier, A., Lawson, T. and Norrie, A. (eds.) *Critical Realism: Essential Readings*. London: Routledge, pp.503-543.

Archer, M. (1998b) Introduction to Part 2 of Archer, M., Bhaskar, R., Collier, A., Lawson, T. and Norrie, A. (eds.) *Critical Realism: Essential Readings*. London: Routledge, pp.189-205.

Archer, M. (1998c) 'Realism and Morphogenesis', in Archer, M., Bhaskar, R., Collier, A., Lawson, T. and Norrie, A. (eds.) *Critical Realism: Essential Readings*. London: Routledge, pp.356-381.

Archer, M. (2000) *Being Human: The Problem of Agency*. Cambridge: Cambridge University Press.

Azer, S. (2009) 'Problem-Based Learning in the Fifth, Sixth and Seventh Grades: Assessment of Students' Perceptions', *Teaching and Teacher Education*, 25, pp.1033-1042.

Barone, T. (1992) 'On the Demise of Subjectivity in Educational Inquiry', *Curriculum Inquiry*, 22(1), pp.25-38.

Bassey, M. (1981) 'Pedagogic Research: on the Relative Merits of Search for Generalisation and Study of Single Events', *Oxford Review of Education*, 7(1), pp.73-94.

Bassey, M. (1999) *Case Study Research in Educational Settings*. Buckingham: Open University Press.

Bassey, M. (2001) 'A Solution to the Problem of Generalisation in Educational Research: Fuzzy Prediction', *Oxford Review of Education*, 27(1), pp.5-22.

Bawden, R. (1988) 'On Leadership, Change and Autonomy', in Boud, D. *Developing Student Autonomy in Learning*. London: Kogan Page.

Bhaskar, R. (1982) 'Emergence, Explanation, and Emancipation', in Secord, P. (ed.) *Explaining Human Behaviour: Consciousness, Human Action and Social Structure*. Beverly Hills, London and New Delhi: Sage.

Bhaskar, R. (1998) 'Societies', in Archer, M., Bhaskar, R., Collier, A., Lawson, T. and Norrie, A. (eds.) *Critical Realism: Essential Readings*. London: Routledge, pp.206-281.

Bhaskar, R. (2005) *The Possibility of Naturalism: A Philosophical Critique of the Contemporary Human Sciences*. 3rd edn. London: Routledge.

Bhaskar, R. (2010) *The Formation of Critical Realism*. Routledge.

Bhaskar, R. (2011) *Reclaiming Reality*. Routledge.

Beauchamps, T. (1992) 'Ethical Issues in Funding and Monitoring University Research', *Business and Professional Ethics Journal*, 11(1), pp.5-16.

Bell, S. (2010) 'Project-Based Learning for the 21st Century: Skills for the Future', *The Clearing House*, 83, pp.39-43.

BERA. (2011) 'Ethical Guidelines for Educational Research', *British Educational Research Association*.

Blumenfeld, P., Soloway, E., Marx, R., Krajcik, J., Guzdial, M. and Palincsar, A. (1991) 'Motivating Project-Based Learning: Sustaining the Doing, Supporting the Learning', *Educational Psychologist*, 26(3 and 4), pp.369-98.

Blumenfeld, P., Marx, R., Soloway, E. and Krajcik, J. (1996) 'Learning with Peers: From Small Group Cooperation to Collaborative Communities', *Educational Research*, 25, pp.37-40.

Boaler, J. (1997) *Experiencing school mathematics; Teaching styles, sex, and settings.* Buckingham, UK: Open University Press.

Boaler, J. (1999) 'Mathematics for the Moment, or the Millennium?', *Education Week*, 17(29), pp.30-34.

Bolton, P. (2017) 'Grammar School Statistics', *House of Commons Briefing Paper* 1398, 10th March 2017.

Bourdieu, P. (1974) 'Cultural Reproduction and Social Reproduction', in Brown, R. (ed.) *Knowledge, Education and Social Change*. London: Taylor and Francis, pp.71-84.

Bourdieu, P. and Passeron, J-C. (1990) *Reproduction in Education, Society and Culture*. 2nd edn. London: Sage.

Boyatzis, R. (1998) *Transforming Qualitative Information: Thematic Analysis and Code Development*. Sage.

Brophy, J. (1983) 'Conceptualizing Student Motivation', *Educational Psychologist*, 18(3), pp.200-215.

Brown, A., Ash, D., Rutherford, M., Nakagawa, K., Gordon, A. and Campione, J. (1989) 'Distributed Expertise in the Classroom', in Salomon, G. (ed.) *Distributed Cognitions: Psychological and Educational Considerations*. Cambridge University Press.

Brown, A. and Palincsar, A. (1989) 'Guided, Cooperative Learning and Individual Knowledge', in Resnick, L. *Knowing, Learning and Instruction: Essays in Honor of Robert Glaser*. Hillsdale, New Jersey: Lawrence Erlbaum Associates, pp.393-451.

Brown, J., Collins, A. and Duguid, P. (1989) 'Situated Cognition and the Culture of Learning', *Educational Researcher*, 18(1), pp.32-42.

Brown, J. and Duguid, P. (1991) 'Organizational Learning and Communities-of-Practice: Towards a Unified View of Working, Learning and Innovation', *Organization Science*, 2(1), pp.40-57.

Bruner, J. (1996) *The Culture of Education*. Harvard University Press.

Bryman, A. (ed.) (1988) *Doing Research in Organizations*. London: Routledge.

Burgess, R. (ed.) (1984) *The Research Process in Educational Settings: Ten Case Studies*. Lewes: Falmer Press.

Burgess, R. (1989) *The Ethics of Educational Research*. Falmer Press.

Busher, H. and James, N. (2002) 'Ethics of Research in Education', in Briggs, A. and Coleman, M. (eds.) *Research Methods in Educational Leadership and Management*. Sage.

Candy, P. (1988) 'On the Attainment of Subject-Matter Autonomy', in Boud, D. *Developing Student Autonomy in Learning*. London: Kogan Page.

Clark, C. (2005) 'The Structure of Educational Research', *British Educational Research Journal*, 31(3), pp.289-308.

Cohen, L., Manion, L. and Morrison, K. (2011) *Research Methods in Education*. 7th edn. London: Routledge.

Collins, A., Brown, J. and Newman, S. (1989) 'Cognitive Apprenticeship: Teaching the Crafts of Reading, Writing, and Mathematics', in Resnick, L. *Knowing, Learning and Instruction: Essays in Honor of Robert Glaser*. Hillsdale, New Jersey: Lawrence Erlbaum Associates, pp.453-494.

Costley, C., Elliott, G. and Gibbs, P. (2010) *Doing Work-Based Research: Approaches to Enquiry for Insider-Researchers*. London: Sage.

Creswell, J. (2013) *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. Sage.

Curzer H. and Santillanes, G. (2012) 'Managing Conflict of Interest in Research: Some Suggestions for Investigators', *Accountability in Research: Policies and Quality Assurance*, 19(3), pp.143-155.

DCSF. (2008) 'The Composition of Schools in England', *Statistical Bulletin* B02/2008, Department of Children, Schools and Families, June 2008. Available at: http://webarchive.nationalarchives.gov.uk/20130321145444/https://www.education.gov.uk/researchandstatistics/statistics/allstatistics/a00195813/the-composition-of-schools-in-england (Accessed: 11 October, 2017 at 10:30).

Davies, B. and West-Burnham, J. (1997) *Reengineering and Total Quality in Schools*. London: Pearson.

Denzin, N. and Lincoln, Y. (eds.) (1994) *Handbook of Qualitative Research*. Sage.

Dirkx, J. and Mezirow, J. (2006) 'Musings and Reflections on the Meaning, Context, and Process of Transformative Learning: A Dialogue between John M. Dirkx and Jack Mezirow', *Journal of Transformative Learning*, April 2006, 4(2), pp.123-139.

Dochy, F., Segers, M., van den Bossche, P. and Gijbels, D. (2003) 'Effects of Problem-Based Learning: A Meta-Analysis', *Learning and Instruction*, 5, pp.533-568.

Dweck, C. (2000) *Self-Theories: Their Role in Motivation, Personality and Development*. Philadelphia, PA: Psychology Press.

Eisner, E. (2017) *The Enlightened Eye: Qualitative Inquiry and the Enhancement of Educational Practice*. Columbia: Teachers College Press.

Elder-Vass, D. (2008) 'Integrating Institutional, Relational and Embodied Structure: An Emergentist Perspective', *British Journal of Sociology*, 59(2).

Englund, T. (1996) 'Historical Notes on the Barriers to the Professionalization of American Teachers: The Influence of Markets and Patriarchy', in Goodson, I. and Hargreaves, A. (eds.) *Teachers' Professional Lives*. London: Falmer.

Ertmer, P., Newby, T. and Macdougall, M. (1996) 'Students' Responses and Approaches to Case-Based Instruction: The Role of Reflective Self-Regulation', *American Journal of Educational Research*, 33, pp.719-752.

Evers, C. and Wu, E. (2007) 'On Generalizing from Single Case Studies: Epistemological Reflections', in Bridges, D. and Smith, R. (eds.) *Philosophy, Methodology and Educational Research*. Oxford: Blackwell.

Feagin, J., Orum, A. and Sjoberg, G. (eds.) (1991) *A Case for the Case Study*. Chapel Hill, NC: University of North Carolina.

Feuerstein, R., Krasilovsky, D. and Rand, Y. (1978) 'Modifiability during Adolescence', in Anthony, J. (ed.) *The Child and His Family: Children and their Parents in a Changing World*. London: Wiley.

Gallagher, S. A., Stepien, W. J., Sher, B. J., and Workman, D. (1995) 'Implementing Problem Based Learning in Science Classrooms', *School Science and Mathematics*, 95, pp.136-146.

Geertz, C. (1973) 'Thick Description: Toward an Interpretative Theory of Culture', in Geertz, C. *The Interpretation of Cultures*. New York: Basic Books.

Geier, R., Blumenfeld, P., Marx., R., Krajcik, J., Fishman, B., Soloway, E. and Clay-Chambers, J. (2008) 'Standardized Test Outcomes for Students Engaged in Inquiry-Based Science Curricula in the Context of Urban Reform', *Journal of Research in Science Teaching*, 45, pp.922-939.

Giroux, H. (1980) 'Critical Theory and Rationality in Citizenship Education', *Curriculum Inquiry*, 10(4), pp.329-366.

Giroux, H. (1981) *Ideology, Culture and the Process of Schooling*. London: Falmer.

Giroux, H. (2006) 'Academic Freedom under Fire: The Case for Critical Pedagogy', *College Literature*, 33(4), pp.1-42.

Glaser, R. (1984) 'Education and Thinking: The Role of Knowledge', *American Psychologist*, 39(2), pp.93-104.

Glaser, B. and Strauss, A. (1967) *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New York: Aldine deGruyter.

Gomm, R., Hammersley, M. and Foster, P. (2000) 'Case Study and Generalization', in Gomm, R., Hammersley, M. and Foster, P. *Case Study Method*. London: Sage.

Gorard, S. and Siddiqui, N. (2018) 'Grammar Schools in England: A New Analysis of Social Segregation and Academic Outcomes', *British Journal of Sociology of Education*. DOI: 10.1080/01425692.2018.1443432.

Grolnick, W. and Ryan, R. (1987) 'Autonomy in Children's Learning: An Experimental and Individual Difference Investigation', *Journal of Personality and Social Psychology*, 52(5), pp.890-898.

Hammersley, M. (2012) 'Troubling Theory in Case Study Research', *Higher Education Research and Development*, 31(3), pp.393-405.

Hart, P. (2006) 'How Should Colleges Prepare Students to Succeed in Today's Global Economy?', *Association of American Colleges and Universities*.

Hattie, J., Biggs, J. and Purdie, N. (1996) 'Effects of Learning Skills Interventions on Student Learning: A Meta-Analysis', *American Educational Research Association*, 66(2), pp.99-136.

Hedges, A. (1985) 'Group Interviewing', in Walker, R. (ed.) *Applied Qualitative Research*. Aldershot: Gower.

Higgs, J. (1988) 'Planning Learning Experiences to Promote Autonomous Learning', in Boud, D. *Developing Student Autonomy in Learning*. London: Kogan Page.

Hmelo-Silver, C. (2004) ‘Problem-Based Learning: What and How do Students Learn?’ *Educational Psychology Review*, 16, pp.235-266.

Holec, H. (1981) *Autonomy and Foreign Language Learning*. Oxford: Pergamon.

Illeris, K. (2014) ‘Transformative Learning and Identity’, *Journal of Transformative Education*, 12(2), pp.148-163.

Jerzembek, G. and Murphy, S. (2013) ‘A Narrative Review of Problem-Based Learning with School-Aged Children: Implementation and Outcomes’, *Educational Review*, 65(2), pp.206-218.

Jones, A. (2014) ‘Fostering Independent Learning: A Critical Reflection on the Establishment of Project-Based Learning in a Selective Secondary School in Canterbury, UK’, Canterbury Christ Church University (unpublished paper).

Jones, A. (2014) ‘What Do Pragmatic and Coherence Theories of Truth Have to Tell Us about the Intrinsic and Instrumental Value of Case Studies?’, Canterbury Christ Church University (unpublished paper).

Jones, S. (1985) ‘The Analysis of Depth Interviews’, in Walker, R. (ed.) *Applied Qualitative Research*. Aldershot: Gower.

Kegan, R. (2000) ‘What Form “Transforms”?: A Constructive-Developmental Approach to Transformative Learning’, in Mezirow, J. and Associates. *Learning as Transformation: Critical Perspectives on a Theory in Progress*. San Francisco: Jossey-Bass.

King, N. (2004) 'Using Templates in the Thematic Analysis of Text', in Cassell, C. and Symon, G. (eds.) *Essential Guide to Qualitative Methods in Organizational Research*. London: Sage.

Kirschner, P., Sweller, J. and Clark, R. (2006) 'Why Minimal Guidance during Instruction does not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential and Inquiry-Based Teaching', *Educational Psychologist*, 41(2), pp.75-86.

Kozulin, A. and Presseisen, B. (1995) 'Mediated Learning Experience and Psychological Tools: Vygotsky's and Feuerstein's Perspectives in a Study of Student Learning', *Educational Psychologist,* 30(2), pp.67-75.

Krajcik, J., Blumenfeld, P., Marx, R., Bass, K., Fredricks, J. and Soloway, E. (1998) 'Inquiry in Project-Based Science Classrooms: Initial Attempts by Middle School Students', *Journal of the Learning Sciences*, 7(3), pp.313-350.

Lave, J. and Wenger, E. (1991) *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.

Lee, H-S. and Butler, N. (2003) 'Making Authentic Science Accessible to Students', *International Journal of Science Education,* 25(8), pp.923-948.

Lincoln, Y. and Guba, E. (1985) *Naturalistic Inquiry*. Beverly Hills: Sage.

Lombardi, M. (2007) 'Authentic Learning for the 21st Century: An Overview', *Educause Learning Initiative*, Paper 1.

Lucas, B., Claxton, G. and Spencer, E. (2013) *Expansive Education: Teaching Learners for the Real World*. Acer Press and Open University Press.

Manicas, P. (1998) 'A Realist Social Science', in Archer, M., Bhaskar, R., Collier, A., Lawson, T. and Norrie, A. (eds.) *Critical Realism: Essential Readings*. London: Routledge, pp.313-338.

May, T. (1997) *Social Research: Issues, Methods and Process*. Buckingham: Open University Press.

Mercer, J. (2007) 'The Challenges of Insider Research in Educational Institutions: Wielding a Double-Edged Sword and Resolving Delicate Dilemmas', *Oxford Review of Education*, 33(1), pp.1-17.

Mezirow, J. (2000) 'Learning to Think Like an Adult: Core Concepts of Transformation Theory', in Mezirow, J. and Associates. *Learning as Transformation: Critical Perspectives on a Theory in Progress*. San-Francisco: Jossey-Bass.

Mezirow, J. (2009) 'An Overview on Transformative Learning', in Illeris, K. *Contemporary Theories of Learning: Learning Theorists in their Own Words*. London: Routledge.

Mitra, S. (2005) 'Self-Organising Systems for Mass Computer Literacy: Findings from the "Hole-in-the-Wall" Experiments', *International Journal of Development Issues*, 4(1), pp.71-81.

Mitra, S. (2007) 'Kids Can Teach Themselves' (TED talk). Available at: http://www.ted.com/talks/sugatamitrashowshowkidsteachthemselves?language=en. (Accessed 14 May, 2015 at 19:28).

Mitra, S. and Dangwal, R. (2010) 'Limits to Self-Organising Systems of Learning: The Kalikuppam Experiment', *British Journal of Educational Technology*, 41(5), pp.672-688.

Moore, Alex. (2012) *Teaching and Learning: Pedagogy, Curriculum and Culture*. Taylor and Francis.

Newby, P. (2009) *Research Methods for Education*. London: Longman.

Newell, R. (2006) *Passion for Learning: How Project-Based Learning Meets the Needs of 21st Century Students*. Rowman and Littlefield.

Newmann, F., Marks, H. and Gamoran, A. (1996) 'Authentic Pedagogy and Student Performance', *American Journal of Education*, 104(4), pp.280-312.

Nicaise, M., Gibney, T. and Crane, M. (2000) 'Toward an Understanding of Authentic Learning: Student Perceptions of an Authentic Classroom', *Journal of Science Education and Technology*, 9(1), pp.79-94.

Nolen, A. and Putten, J. (2007) 'Action Research in Education: Addressing Gaps in Ethical Principles and Practices', *Educational Researcher*, 36(7), pp.401-407.

Nowell, L., Norris, J., White, D. and Moules, N. (2017) 'Thematic Analysis: Striving to Meet the Trustworthiness Criteria', *International Journal of Qualitative Methods*, 16, pp.1-13.

Osberg, D. and Biesta, G. (2008) 'The Emergent Curriculum: Navigating a Complex Course between Unguided Learning and Planned Enculturation', *Journal of Curriculum Studies*, 40(3), pp.313-328.

Palfreyman, D. (2003) 'The Representation of Learner Autonomy and Learner Independence in Organizational Culture', in Palfreyman, D. and Smith, R. (eds.) *Learner Autonomy across Cultures*. Palgrave Macmillan.

Phillips, D. (1995) 'The Good, the Bad, and the Ugly: The Many Faces of Constructivism', *Educational Researcher*, 24(7).

Piaget, J. (1954) *The Construction of Reality in the Child*. New York: Basic Books.

Piaget, J. (1971) *Science of Education and the Psychology of the Child*. Penguin Books.

Pole, C. and Morrison, M. (2003) *Ethnography for Education*. Buckingham: Open University Press.

Porpora, D. (1998) 'Four Concepts of Social Structure', in Archer, M., Bhaskar, R., Collier, A., Lawson, T. and Norrie, A. (eds.) *Critical Realism: Essential Readings*. London: Routledge, pp.339-355.

Potts, D. (1988) ‘One-to-One Learning’, in Boud, D. *Developing Student Autonomy in Learning*. London: Kogan Page.

Priestley, M. (2011) ‘Whatever Happened to Curriculum Theory? Critical Realism and Curriculum Change’, *Pedagogy, Culture and Society*, 19(2), pp.221-237.

Pritchard, A. (2009) *Ways of Learning: Learning Theories and Learning Styles in the Classroom*. 2nd edn. London: Routledge.

Ranson, S., Martin, J., Nixon, J. and McKeown, P. (1996) ‘Towards a Theory of Learning’, *British Journal of Educational Studies*, 44(1), pp.9-26.

Ravitz, J. (2008) *Project-Based Learning as a Catalyst in Reforming High Schools*. New York: AERA.

Resnick, D. and Elliott, K. (2013) ‘Taking Financial Relationships into Account when Assessing Research’, *Accountability in Research: Policies and Quality Assurance*, 20(3), pp.184-205.

Robson, C. (2011) *Real World Research*. Wiley.

Rosenholtz, S. (1989) *Teachers’ Workplace: The Social Organization of Schools*. New York: Longman.

Ryan, R. and Deci, E. (2000) ‘Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions’, Contemporary Educational Psychology, 25 (54-67).

Sayer, A. (1984) *Method in Social Science: A Realist Approach*. London: Hutchinson.

Schon, D. (1991) *The Reflective Practitioner: How Professionals Think in Action*. Ashgate.

Scott, D. and Usher, R. (1999) *Researching Education: Data, Methods and Theory in Educational Enquiry*. London: Cassell.

Simons, H. (ed.) 1980. *Towards a Science of the Singular*. University of East Anglia: Centre for Applied Research in Education.

Simons, H. (2009) *Case Study Research in Practice*. London: Sage.

Simons, H. and Usher, R. (2000) *Situated Ethics in Educational Research*. London: Routledge.

Smith, R. (1997) 'The Education of Autonomous Citizens', in Bridges, D. *Education, Autonomy and Democratic Citizenship: Philosophy in a Changing World*. Routledge.

Smith, R. (2003) 'Pedagogy for Autonomy as (Becoming -) Appropriate Methodology', in Palfreyman, D. and Smith, R. (eds.) *Learner Autonomy across Cultures*. Palgrave Macmillan.

Stake, R. (1994) 'Case Studies', in Denzin, N. and Lincoln, Y. (2000) *Handbook of Qualitative Research*. Sage, pp.236-247.

Stake, R. (1995) *The Art of Case Study*. Newbury Park, CA: Sage.

Stake, R. (1998) ‘Intrinsic and Instrumental Interest in Cases’, in Denzin, N. and Lincoln, Y. (eds.) *Strategies of Qualitative Inquiry*. Sage, pp.88-105.

Steinberg, A. (1998) *Real Learning, Real Work: School to Work as High School Reform*. Routledge.

Stenhouse, L. (1978) ‘Case Study and Case Records: Towards a Contemporary History of Education’, *British Educational Research Journal*, 4(2), pp.21-39.

Sternberg, R. (2003) ‘What is an “Expert Student”?’, *Educational Researcher*, 32(8), pp.5-9.

Stroh, M. (2000) ‘Qualitative Interviewing’, in Burton, D. *Research Training for Social Scientists*. London: Sage.

Sungur, S., Tekkaya, C. and Geben, O. (2006) ‘Improving Achievement through Problem-Based Learning’, *Educational Research*, 40, pp.155-160.

Tellis, W. (1997) ‘Application of a Case Study Methodology’, *The Qualitative Report*, 3(3).

Thomas, J. (2000) *A Review of Research on Project-Based Learning*. The Autodesk Foundation.

Vieira, F. (2003) ‘Addressing Constraints on Autonomy in School Contexts: Lessons from Working with Teachers’, in Palfreyman, D. and Smith, R. (eds.) *Learner Autonomy across Cultures*. Palgrave Macmillan.

Vygotsky, L. (1978) *Mind in Society: The Development of Higher Psychological Processes*. Harvard University Press.

Vygotsky, L. (1986) *Thought and Language*. Cambridge, MA: MIT Press.

Walker, R. (1985) ‘An Introduction to Applied Qualitative Research’, in Walker, R. (ed.) *Applied Qualitative Research*. Aldershot: Gower.

Watts, M. and Ebbutt, D. (1987) ‘More than the Sum of the Parts: Research Methods in Group Interviewing’, *British Educational Research Journal*, 13(1), pp.25-34.

Wenger, E. (1999) *Communities of Practice: Learning, Meaning and Identity*. Cambridge University Press.

Wenger, E. (2009) ‘A Social Theory of Learning’, in Illeris, K. *Contemporary Theories of Learning: Learning Theorists in their Own Words*. London: Routledge.

West, L. (1996) *Beyond Fragments: Adults, Motivation and Higher Education: A Biographical Analysis*. Taylor and Francis.

West, L. (2014) ‘Transformative Learning and the Form that Transforms: Towards a Psychosocial Theory of Recognition Using Auto/Biographical Narrative Research’, *Journal of Transformative Education*, 12(2), pp.164-179.

Winter, R. (1989) *Learning from Experience: Principles and Practice in Action-Research*. London: Falmer Press.

Winter, R. (1996) 'Some Principles and Procedures for the Conduct of Action Research', in Zuber-Skerritt, O. (ed.) *New Directions in Action Research*. London: Falmer.

Wolcott, H. (1994) *Transforming Qualitative Data: Description, Analysis and Interpretation*. Sage.

Wood, D., Bruner, J. and Ross, G. (1976) 'The Role of Tutoring in Problem-Solving', *Journal of Child Psychology and Psychiatry*, 17, pp.89-100.

Wurdinger, S., Haar, J., Hugg, R. and Bezan, J. (2007) 'A Qualitative Study using Project-Based Learning in a Mainstream Middle School', *Improving Schools*, 10(2), pp.150-161.

Yin, R. (2014) *Case Study Research: Design and Methods*. Thousand Oaks, CA: Sage.

Appendices

List of appendices:

Appendix 1: Research agreement

Research Agreement

The following is an agreement on the ethical and procedural arrangements made between:

- Alan Jones: Researcher, Canterbury Christ Church University, and
- [Head Teacher and principal gatekeeper of the case study school]

with regard to case study research to be conducted at the above school beginning in September, 2015.

Initial statement

The researcher (Alan Jones) acknowledges the financial support received from [the case study school] in enabling the researcher to complete a Doctorate in Education course at Canterbury Christ Church University, culminating in a qualitative research project examining an aspect of learning in the school. The school acknowledges the opportunity provided by the research to analyse from a distance, through a properly critical, informed research perspective, the impact of the school's pedagogy and make more broadly available for students, parents, governors, the local community and other similar institutions the independent findings of the researcher. Both the researcher and the school wish to affirm that a context of trust exists between the two which is strongly beneficial to the research process.

The undersigned agree to the following conditions for the undertaking of the research referred to above:

1. That the researcher will communicate to the school through the principal gatekeeper details of the precise focus of the research, the methodology and methods to be employed, the means by which the data will be collected and analysed and the final independent conclusions of the complete study, whilst recognising that the dynamics of research may occasion negotiated changes of approach during the study itself.

2. That, whilst the researcher may work closely with the gatekeeper to identify appropriate sources of data, the final choice of subjects and sources for research will in all cases be entirely the researcher's.
3. That decisions about which data to include for analysis and how to proceed with the analysis itself will be entirely those of the researcher alone.
4. That the final conclusions of the research study will be those of the researcher alone.
5. That records of all data obtained (including those not selected for analysis), analyses undertaken and any final conclusions reached will be provided for/communicated to the case study school via the gatekeeper and for/to all participants in the study, where appropriate and feasible. The final thesis, if successfully approved, will be held and freely available to read at Canterbury Christ Church University Library (Augustine House).

Signed: Alan Jones and [the head teacher of the case study school] Date: 10/11/2015.

Appendix 2: List of the main projects undertaken by students

List of major student research projects

This list refers only to those student research projects involving more than one student. Other, individual, research activities are explained during the discussion of the data from the study.

The Astronomy Project

This project used the observatory facility in the Star Centre of the case study school, a building specially constructed to provide a hub for student science research. Students undertook observations of space phenomena and recorded and analysed their results. Work on tracking near-earth objects contributed to real world research work in this area. Part of the work of this project group was the outreach initiative with other schools and public observation sessions attended by members of the local community.

The CERN-at-Sea Project

Like the LUCID Project (see below), this project group used the detector chips from a nuclear research facility in Switzerland, the Conseil Européen pour la Recherche Nucléaire (CERN). Building on the achievements of LUCID, the team attached the chips to a wave-powered ocean-going vehicle called the Autonaut. The research involved analysing and improving the data obtained from the chips in order to contribute to real-world understanding of ecological and environmental problems. The team has worked directly with a UK commercial company in trialling the vehicle and software, and a member of the team has gone on to work full-time for the same company.

The Clock Project

This is one of several projects undertaken in the Design and Engineering department. The project team were commissioned to produce a clock to be displayed in a prominent position in a recently constructed shopping centre. Their work was sponsored by the Parents' Association at the school and their design, for a water clock, was the result of intensive research into materials and mechanisms. The students worked closely with parents on the design. The clock remains in place in the shopping centre and is functioning successfully. The location is very close to where the original school buildings were bombed in a Baedeker Raid in the Second World War.

The Frankenstein Project

Students in this project worked independently, taking their writing beyond the level expected at A Level and directly confronting entrenched critical positions on Mary Shelley's novel *Frankenstein* (for example, psychological and feminist perspectives) through intensive research. The project celebrated the bicentenary of the genesis of the novel, and the resultant academic essays were gathered together in a book, *Hideous Progeny: Bicentenary Essays on Mary Wollstonecraft Godwin's Frankenstein*, which appeared in an imprint specifically designed to publish student work professionally.

The Historical Geography (Tambora) Project

This project group carried out research into the impact of the eruption of Mount Tambora in Indonesia in 1815 on the 19th century inhabitants of Kent. The eruption caused the

‘year without a summer’ at various points across the globe, as a result of the volcanic ash emitted. The group compiled a report which substantially added to what is known about the local effects of the eruption, using, for example, primary sources from cathedral archives and meteorological data.

The LUCID Project

This project, the longest-running at the school, came about as a result of students’ independent suggestion that the detector chips from a nuclear research facility in Switzerland, the Conseil Européen pour la Recherche Nucléaire (CERN), could be used to detect the ionising radiation emitted by cosmic ray particles in low earth orbit. These particles, at a sufficient level of intensity, could cause disruption to communications systems and potentially affect the health of astronauts working in space stations. A satellite was launched in 2014 which carried the students’ detector into space, and the work of the project is now to refine the way the data from the satellite is collected and analysed to provide clearer evidence for the international space science community. This work was allied to work in another, smaller, project (RAY) which examined the effects of cosmic ray particles on the earth’s surface. These two enterprises led to the setting-up of another important science project, CERN-at-Sea (see above).

The Myelin Basic Protein (MBP) Project

As part of the push to find a cure for multiple sclerosis, students in this long-running project have been involved in intensive, highly focused laboratory work examining how the myelin sheath breaks down under the influence of certain proteins. A large number of students were recruited initially to carry out this research work, and this recruitment

has been sustained through funding from The Wellcome Trust. The students have worked closely with researchers from a local university and have attended professional research symposia to present their work. At the time of writing, there are also plans to publish research papers in online science journals.

The Pollen Project

One of two research projects in geography (see the Historical Geography [Tambora] Project above). In this collaborative work, students used microscopes and other equipment to analyse pollen grains extracted from bore samples taken from Whiteham Woods in Oxfordshire. The aim of the project was to contribute to knowledge about human habitation and movement and their influence on the environment tens of thousands of years ago through inference from pollen and other evidence in the samples. The work was supported by the Royal Geographical Society.

The Polymer Project

In this chemistry project, students were carrying out intensive laboratory work on polymer chains by looking at the absorption of different solvents. The project began in school but later students worked with PhD students at a local university. The results of the school students' research were incorporated into the theses of the doctoral students upon completion of their doctorates, and students also attended professional research symposia in London to present their work.

The R-Gen Project

This is one of several projects undertaken in the Design and Engineering department. Through a scheme linking schools to commercial companies, this project team were commissioned to design, and produce a prototype of, a kinetic charging device. The team carried out research into similar existing products and into energy generation methods, the kinds of component needed and the logistics of prototype manufacture. The final, award-winning product, R-Gen, proved capable of generating energy successfully in outdoor environments (such as music festivals and remote locations) and the associate company went on to investigate the possibility of developing a full commercial product.

The World War One Project

Within one larger project group, students here were working in smaller teams or alone to investigate different aspects of the impact of the run-up to, and aftermath of, the First World War on the people of Kent, testing national mythologies against one set of local realities. Research areas included the impact on women, how the war was reflected in popular entertainment and the impact of garrisoned soldiers just before and during the period of war. Primary archive sources and family histories were two important sources of evidence. The completed research featured in public displays, short papers and informal talks.

Appendix 3: List of student, teacher and school leader participants

This appendix should be read in conjunction with Appendix 2 (the list of the main student research projects). The names of students, teachers and school leaders in the information below have been anonymised, in line with my undertaking not to use real names when discussing data from their interviews.

The students

Student A: A female student who had enrolled at the case study school in Year 12 to pursue science A Level courses. She was at the end of Year 12 at the time of interview. Her principal involvement was with the CERN-at-Sea Project.

Student B: A male student who had been enrolled at the case study school from Year 7. He was pursuing A Level courses in the humanities. He was at the beginning of Year 13 at the time of interview. His principle involvement was with the Pollen Project in geography.

Student C: A male student who had been enrolled at the case study school from Year 7. He was pursuing A Level courses in the sciences. He was at the beginning of Year 13 at the time of interview. His principle involvement was with the LUCID Project in physics, in a leadership role.

Student D: A male student who had been enrolled at the case study school from Year 7. He was pursuing A Level courses in mathematics, science and computing. He was at the beginning of Year 13 at the time of interview. He was involved with research into data encryption and quantum computing and took a leadership role with younger students in the First Lego League robotics and mechanics project whilst in Year 12.

Student E: A female student who had enrolled at the case study school in Year 12 to pursue A Level courses in science and design. She was at the end of Year 12 at the time of interview. Her principal involvement was with the R-Gen design/engineering project, where she took a leadership role.

Student F: A male student who had enrolled at the case study school in Year 12 to pursue A Level courses in mathematics and science. He was at the beginning of Year 13 at the time of interview. He was pursuing his own research into different forms of statistics and was also involved in the Polymer Project in chemistry.

Student G: A female student who had enrolled at the case study school in Year 12 to pursue A Level courses in English and humanities subjects. She was towards the end of Year 13 at the time of interview. Her principal involvement was with the *Frankenstein* Project in English.

Student H: A female student who had enrolled at the case study school in Year 12 to pursue A Level courses in English, the humanities and art. She was at the beginning of

Year 13 at the time of interview. Her principal involvement was with the *Frankenstein* Project in English.

Student I: A female student who had enrolled at the case study school in Year 12 to pursue A Level courses in sciences and the humanities. She was at the beginning of Year 13 at the time of interview. Her principal involvement was with the First World War Project in history.

Student J: A male student who had been enrolled at the case study school from Year 7. He was pursuing A Level courses in mathematics and the sciences. He was at the beginning of Year 13 at the time of interview. His principle involvement was with the RAY and MBP Projects in physics and biology respectively.

Student K: A male student who had been enrolled at the case study school from Year 7. He was pursuing A Level courses in mathematics, music and the sciences and was towards the end of Year 13 at the time of interview. He was pursuing his own independent research into the effects of music, and specifically singing, on people with Parkinson's.

Student L: A male student who had enrolled at the case study school in Year 12. He was pursuing A Level courses in mathematics, computing, physics and philosophy. He was towards the end of Year 12 at the time of interview. His principle involvement was with the Astronomy Project (in a leadership role) and with the LUCID Project in physics.

Student M: A male student who had been enrolled at the case study school from Year 7. He was pursuing A Level courses in mathematics, sciences and geography. He was towards the end of Year 12 at the time of interview. His principle involvement was with the MBP Project in biology, but he also carried out independent research into the effects of learning and playing chess on people with dementia.

Student N: A female student who had enrolled at the case study school in Year 12 to pursue A Level courses in science. She was towards the end of Year 12 at the time of interview. Her principal involvement was with the Polymer Project in chemistry.

Student O: A female student who had enrolled at the case study school in Year 12 to pursue A Level courses in mathematics, science and philosophy. She was at the beginning of Year 13 at the time of interview. Her principal involvement was with the MBP Project in biology and the Polymer Project in chemistry.

Student P: A male student who had been enrolled at the case study school from Year 7. He was pursuing A Level courses in design and the humanities. He was at the beginning of Year 13 at the time of interview. His principle involvement was with the First World War Project in history.

Student Q: A female student who had enrolled at the case study school in Year 12 to pursue A Level courses in mathematics, sciences and geography. She was towards the

end of Year 12 at the time of interview. Her principal involvement was with the Historical Geography (Tambora) Project in geography.

Student R: A male student who had enrolled at the case study school in Year 12 to follow design and science courses at A Level. He was at the beginning of Year 13 at the time of interview (group interview only). His principle involvement was with the Clock Project in design/engineering.

The teachers and school leaders

The head teacher: Having arrived at the case study school in 2001, the head teacher carried out a process of change to move the culture of the school towards one based on effective teaching and learning and challenge for its selective students, this process forming the subject of a doctoral thesis (2003). He facilitated the growth of research-based approaches by building on innovative work in science. He steered the school towards an OFSTED accreditation of Outstanding (2013). Now the executive head teacher of two selective schools.

Teacher 1: The Head of Physics at the time of interview. Former Science Teacher of the Year. Instigator and lead teacher of a range of research projects in physics, including LUCID. One of the first teachers to involve students in research-based learning at the case study school.

Teacher 2: Teacher of biology. Instigator and lead teacher of the Myelin Basic Protein (MBP) project. Involvement in this research was partly driven by first-hand experience of the effects of multiple sclerosis.

Teacher 3: Teacher of history. Instigator and lead teacher of the First World War Project in history. Other responsibilities included the management of history coursework at A Level.

Teacher 4: The Head of Design. Instigator and lead teacher of student design/engineering research and development projects, including the Clock and R-Gen projects.

Teacher 5: Teacher of geography and Head of Research across all subjects at the case study school (at the time of interview). Instigator and lead teacher of two projects, the Historical Geography (Tambora) Project and the Pollen Project. In her role as Head of Research, she introduced a research fair at the start of Year 12 and closer monitoring of all the student research projects.

Teacher 6: The former Head of Science, in post during the early development of science projects such as LUCID, with overall responsibility for the development of the sciences at the case study school.

Teacher 7: The Head of Humanities at the time of interview, with responsibility for developing student research initiatives in the humanities. Oversight of students' involvement in Extended Project Qualification (EPQ) projects across all subjects. Instigator of the *Frankenstein* Project and an imprint for the publication of student work.

Teacher 8: Physics teacher and Advanced Skills Teacher at the time of interview. Responsible for outreach work and professional development in science teaching at the case study school and in other schools.

Appendix 4: Participant information sheet

Research into Authentic Learning at [the case study school]

PARTICIPANT INFORMATION SHEET

A research study is being conducted at Canterbury Christ Church University (CCCU) by Alan Jones.

This research you will be involved with at [the case study school] will focus on the idea of 'authentic learning', that is, learning involving knowledge and skills beyond what is usual for your age. Authentic learning may involve finding out about, or learning how to do, completely new things, or existing things looked at in a wholly new way. It may take you beyond conventional school learning and examination syllabuses and involve working with experts or authorities in the 'real world'. Such involvement may mean genuinely new research and an experience where some of the decision-making about what, where, when and how to learn are made by you, on your own or in collaboration with others.

What will I be required to do?

You have been invited, as one of a group of about 20 students, to participate in one-to-one interviews with the researcher, in which you can give more detailed responses about how you understand the nature of your involvement in authentic learning, the kinds of roles you have undertaken and the types of relationship you have established as a result of your involvement.

Why have I been invited?

Because you are a student at [the case study school] in Year 12 or Year 13 during 2015-16 and have had some involvement in authentic learning (see above).

What will I be expected to do?

You will be invited to participate in an interview and may be observed at work in an appropriate learning environment, such as a classroom, research area or workplace outside school.

How can I find out the results of the research?

You will be able to request a summary of the overall research findings at the end of the research.

Who will know about the information I give?

Your information will not be shared with teachers at the school or anyone else, and no-one will be able to identify you from the information you give. All information will be stored securely in accordance with the Data Protection Act 1998 and the University's data protection requirements and can only be accessed by Alan Jones. After completion of the study, all personal information will be removed. The results of the study will form part of a thesis presented as part of a doctorate in education at Canterbury Christ Church University. The thesis, if accepted, will be freely available to read.

Do I have to take part?

Your participation is completely voluntary. If you opt not to take part, it will have no effect whatsoever on your life in school or access to learning and other activities. If you have any questions or concerns about participating do not hesitate to contact me. Should you decide to participate, you will be free to withdraw at any time during the process without having to give a reason.

Any questions?

Please contact Alan Jones by email on alandennisjones@talktalk.net.

Appendix 5: Interview themes

Appendix 5a. For students

Themes and exemplar questions for individual student interviews:

The student's own personal experience of authentic learning, e.g.:

- Can you tell me about your experience of authentic learning? [Sufficient fundamental knowledge? Support/scaffolding? Disorientation/challenge?]
- What was your motivation in becoming involved in authentic learning? [Intrinsic/extrinsic?]
- Can you describe any one authentic learning activity you have been involved in which you have found particularly interesting and rewarding? [Unknown? Loose definition? Real audience? Product?]
- Can you tell me about the learning that occurs in authentic learning situations? How different is it from learning in other situations? [Unknown? Loose definition? Real audience? Product?]

The role/s the student takes during an authentic learning experience, e.g.:

- How do you think of yourself as a learner when you are participating in authentic learning situations? [Insider/outsider? Responsibility? Intrinsic motivation?]
- How does this perception compare with your perception of yourself as a learner during more conventional lessons, both now and in the past? [Insider/outsider? Responsibility? Intrinsic motivation?]

The relationships the student has formed during authentic learning, e.g.:

- How would you describe your relationships with students/teachers/other adults when working in authentic learning situations? [Discourse? Collaboration? Autonomy? Leadership?]
- How do they compare with relationships you have formed during more conventional lessons, both now and in the past? [Autonomy? Extrinsic motivation? Outsider?]

The student's autonomy and experience of working collaboratively, e.g.:

- To what extent have you been able to make important decisions on your own in authentic learning situations? Can you give an example? [Autonomy? Leadership?]
- Have you worked collaboratively with other students, or with teachers and other adults, in working within authentic learning situations? If so, can you give an example? [Discourse? Leadership?]
- Which have you found more enjoyable and/or effective within authentic situations – working on your own or working with others? [Autonomy? Collaboration?]

The environments in which authentic learning happens, e.g.:

- Can you tell me about how you have used areas within the school during authentic learning, and any tools and techniques you have employed which are part of the work?
- Have you been involved in authentic activities which have taken place outside the school environment? How positive was this experience?

The previous learning experiences of the student

- Were you a student at this school in Years 7-11? If so, can you say whether you feel authentic learning is something that happens lower down in the school?
- If you were not a student at this school in Years 7-11, can you say to what extent the authentic learning you have participated in at this school is different from the learning you experienced at your previous school?

Future learning

- Do you feel your experience of authentic learning will be beneficial to you in later life, whether in purely personal terms, in further study or in employment?

Appendix 5b. For teachers/school leaders (example)

Interview with Teacher 1

1. Can you give me a brief outline of the work you've done at the school, going back to the earliest Physics projects students were involved with? (or pick one early project and one more recent?)
2. What are the links between what students do/learn in research activities and what they do/learn in conventional sixth form science lessons?
3. Do you think that student roles and relationships, and how they see themselves as learners, are different when in research mode? What are the differences?
4. (Read Lave and Wenger and TES extracts) To what extent do students develop an authentic disciplinary understanding – being physicists rather than physics students – and what are the limits to their joining the community of physics and physicists outside school?
5. How authentic are the tasks undertaken by students in Physics? How open are they? Do they come from you, or do the students have a role in deciding what the area of research is and what the methods required are? Are students exploring unknowns, or are they essentially replicating what's already known? Example/s?
6. How far are students initially disorientated by seemingly insurmountable problems, dilemmas and logistical difficulties in what you invite them to do? What effect do these have on them?
7. How do you ensure that students have sufficient fundamental knowledge and understanding to participate in the research? How much 'scaffolding' do you provide for the students, especially early on? To what extent can this be removed?
8. To what extent do students take responsibility for their work, developing intrinsic motivation (see geography)? Evidence?
9. What part does collaboration – between students and between students and teachers/other adults – play in the work?
10. To what extent are there real audiences for students' work, and is there a 'finished product' at the end of it?
11. Is your way of working in Physics through research effective for *all*, or is it mainly taken up by a small number of particularly keen and able students?

Appendix 6: Codings

Node (coding) structure using Nvivo 11

1. Achievement and assessment

2. Aims and methods
    a. Audience
    b. Goal
    c. Knowledge construction
    d. Problem-solving
    e. Product
    f. Reflection
    g. Support/scaffolding/ZPD

3. Conventional vs Authentic Learning
    a. Challenge
    b. Disruption/disorientation
    c. Real world activity

4. Critical realism
    a. Reproduction
    b. Transformation

5. Future life and learning

6. Gender

7. Inclusive/exclusive

8. Learning culture
    a. Case study school
    b. General

9. Previous learning experiences

10. Relationships
    a. Student-outsider
    b. Student-student
    c. Student-teacher

11. Roles
    a. Autonomy
    b. Collaboration
    c. Expert
    d. Insider/outsider
    e. Intrinsic/extrinsic motivation
    f. Leadership
    g. LPP/apprenticeship
    h. Responsibility

12. Soft skills

13. Subjects and domains
    a. Differences between subjects
    b. Disciplinary understanding
    c. Knowledge
    d. Skills in subjects or domains

Superordinate themes arising from the above:

1. Real-world professionalism
2. Student autonomy
3. Student motivation
4. Student relationships
5. The culture of the school and research-based learning